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**STRANGE INSECTS
AND THEIR STORIES**

The Works of
A. HYATT VERRILL

THE INCAS' TREASURE HOUSE

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**STRANGE SEA SHELLS AND THEIR
STORIES**

**STRANGE INSECTS AND THEIR
STORIES**

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STRANGE INSECTS AND THEIR STORIES

How they live. Various kinds and species. Curious traits. Their intelligence. Ways of communicating with each other. Battle for survival. Benefit to all mankind, etc., etc.

BY
A. HYATT VERRILL

AUTHOR OF "THE INCAS' TREASURE HOUSE"
"THE DEEP SEA HUNTERS" ETC.

ILLUSTRATED BY THE AUTHOR

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INTRODUCTION

AMONG all the groups of living creatures none are more interesting and none have stranger lives and habits than the insects. In fact some insects have such amazing ways that they seem almost incredible and cause us to wonder if these little creatures do not possess a real intelligence and reasoning power instead of an instinct as most scientists believe. But even the scientists cannot explain many of the strange habits of insects. No one has yet been able to explain how a moth or a butterfly knows and recognizes the particular plant on which her eggs must be laid in order to provide the caterpillars with their proper food. Can it be possible that her tiny cellular structure which serves her as a brain retains any memory of her own previous existence in caterpillar form? It scarcely seems possible, for during the chrysalis phase of her existence a complete change took place in the creature's tissues. The caterpillar's whole anatomy was altered, and if memory of the caterpillar stage and food plant could survive, then we face a fact even more remarkable than the "instinct" which leads the winged creature to the proper plant for her offspring's nourishment. For that matter, no naturalist can really explain how or why an insect, newly emerged from a pupa and with its previous existence confined to crawling about, can spread its newly formed wings and fly off without the slightest effort or practice, whereas

INTRODUCTION

a fledgling bird must be taught to fly and a human infant must be taught how to use its legs. And how does it happen that a larva, which devours leaves or sucks the sap of a plant, can change into a foodless pupa and later emerge as a winged insect which at once dines on the nectar of flowers or perhaps seeks and devours other insects? Do the amazing ants, who outdo man in many of their feats, possess reasoning powers, intelligence, a true mental process, or is it blind instinct which controls their actions? And what marvelous and inexplicable power guides many insects to assume attitudes or select surroundings which causes them to become almost invisible to their foes? No one knows, no one can say, but the more we study insects, and the more we learn of their strange habits and their stories, the more we are convinced that there must be a Supreme power which regulates the lives of all things and functions on a definite Plan which Nature must inevitably follow.

But quite aside from all this. Apart from the mystery of insects' lives and habits, a vast number of insects are most fascinatingly interesting. Among them we find nearly every art, industry and phase of human activity duplicated. There are insect masons, carpenters, weavers, divers, aviators and bridge builders. There are insect soldiers and sailors, insect miners and farmers, insect basket makers and engravers, insects who keep cattle, and insects who have slaves. There are lazy insects and industrious insects. Insects with well built fixed homes and insect hoboes. Some insects are quarrelsome, quick tempered, morose or vicious, while others are easy-going, docile, good natured and give the impression of being always happy. There are industrious and lazy insects and while

many have no particularly unusual or remarkable habits or lives but merely follow the customary and well known manner of existence, there are countless others which are most remarkable and strange. In fact there are so many strange insects known that not one but many volumes would be needed to describe them and tell their stories. But many of these are either very rare or are so difficult to find or study that they would never come under the notice of the ordinary mortal, and in this book I have not attempted to tell the stories of even a small portion of the strange insects of our earth. Instead, I have selected only those which anybody may observe, either in the north or in the tropics, and I have endeavored to select types of families and genera with similar habits rather than definite species.

Unquestionably many of my readers will recognize some of the insects whose stories I have told, and if they are not already familiar with the lives and habits of the little creatures, they will be surprised to learn how interesting and unusual they are. Others, who perhaps have noticed the odd ways or strange habits of certain insects may be interested in finding out what the creatures are and why they behave as they do, while there are many who have never considered insects other than as pests, and lacking in all interest, who it is hoped, will discover by reading these stories that among the lowly insects we may find the most amazing and most interesting habits of the entire animal world.

A. HYATT VERRILL.

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THIS INSECT:

- (1) Is a Jack-in-the-Box
- (2) Is a Faker
- (3) Steals Rides
- (4) Is Used for Jewelry
- (5) Cuts Down Trees
- (6) Is a Counterfeiter
- (7) Is a Buratoo
- (8) Rolls a Ball
- (9) Is a Humbug
- (10) Fires Gas Bombs
- (11) Buries the Dead
- (12) Traps Other Insects

STRANGE INSECTS AND THEIR STORIES

CHAPTER I

MAN'S GREATEST FOES AND FIRMEST FRIENDS

OF all the many forms of animal life dwelling upon the surface of our planet the insects are the most numerous. They are found everywhere from the Arctic and Antarctic regions to the Equator, and in every possible situation. They burrow in the earth, swim in the water, invade houses and buildings, flit through the air, and crawl, fly, hop or dwell in the grass, plants, trees and vegetation. In fact some even live on snow and ice while others are quite happy and content in the bubbling steaming water of geysers and volcanic craters. Their food is as varied as their homes, and there is scarcely anything in Nature which does not serve as meals for some insect or another. Many are vegetarians, others are carnivorous. Some feed on most delectable substances while others prefer to dine on most astonishing things. There are insects who find tobacco, cigars and cigarettes the most to their taste while others may thrive on poisons or even devour red pepper and live happily and contentedly on the fiery substance. And of course, as everyone knows only too well, there are many insects who are bloodthirsty creatures and make

STRANGE INSECTS

life miserable for man and beast by their insatiable appetites.

The number of kinds or species of insects is almost incredible. Over 300,000 species have been described, yet only a small portion of the whole are known to scientists. Everywhere new species are being found, and it has been estimated that the total number of distinct species runs into many millions. The total number of insects living on our earth is far beyond human conception. As I have said, they greatly outnumber all other forms of animal life and small as they are, their total weight would be greater than that of all other land animals including human beings. At times such vast swarms of locusts sweep down upon portions of many lands that they actually darken the sky in their flight and when alighting they cover the earth for many square miles with a solid living blanket, devour every vestige of vegetation and leave the land a veritable desert. The sound of their jaws may be heard for a long distance, they stop railway trains, and actually kill cattle by their smothering millions. Our minds cannot realize the incalculable numbers of these fearfully destructive grasshoppers, but some vague idea may be obtained when I state that in the little island of Crete 1300 tons of locust eggs were destroyed in a single year, yet so many survived that over 4000 tons of eggs were laid the next year which means that at least 100 billion eggs were laid. Yet locusts are not the most numerous of insects. Everyone is familiar with the common plant lice or aphids, but how many of us realize that a single aphid is capable of producing 6000 million others during the course of its short life? Of course, if this was done and the aphid population was unchecked, it would be only a short time before the entire

vegetation of the world was destroyed by plant lice, for Professor Huxley estimated that ten generations of aphids, if allowed to increase unchecked, would produce a quantity of plant lice weighing more than all the human beings together. Fortunately for man and for the earth, however, aphids like nearly all other insects have countless enemies who are constantly devouring them. In the insect world there is only one law: eat without being eaten, and lay eggs. Everywhere an unending, ceaseless, pitiless warfare is going on among the insects. On every side, everywhere, in the air, under the earth, amid the foliage, under the bark of trees and even in the water and in solid wood there are hungry creatures ever on the watch for other insects on which to feed, while the vegetarian species must be ever on the alert to survive long enough to lay their eggs to produce more of their kind to provide more food for their savage foes. Dame Nature, however, sees to it that a balance is maintained. At least Nature manages very well indeed until mankind interferes with her plans. Then when the balance is upset or man steps in and defies Nature's laws trouble is apt to follow. Destructive insects may be introduced to one district from another and although these may have insect enemies which keep them within bounds in their natural home, there may be no such foes in their new home, and then they increase so rapidly that they get beyond all control. Such was the case with the Japanese beetle, the elm tree beetle, the canker worm, the army moth, and many other insects which have played havoc with crops and have caused millions of dollars worth of damage in the United States. But if man can find an insect foe of the pests, he may introduce these and thus restore Nature's balance. In California, the scale in-

STRANGE INSECTS

sects introduced from other lands threatened to destroy the entire orange groves until a little beetle—the Vedalia lady bug—was introduced from Australia, and preying upon the scale insects solved the problem and saved the fruit orchards. But it sometimes happens that an enemy of a certain insect pest introduced to destroy the pest finds other food that suits it better and devours useful insects and lets the injurious ones alone, and as a result, matters become even worse than before. Moreover, it is not always possible to find an insect enemy of some pest, and even when found it often happens that the enemy will not survive in its new home even if its natural prey does. Of course it is dangerous to meddle with old Mother Nature and her laws and upset her nicely adjusted balance, especially in the insect world. But man began upsetting that balance the moment he started cultivating the land and raising crops in the dim and distant past, and he has been upsetting it more and more as he migrated from place to place and carried his animals and his plants with him and fought the noxious insects that injured his herds and flocks, his crops and himself. Yet what was poor man to do? Terrible maladies—malaria, yellow fever, spotted fever and other dread diseases were transmitted by insects.

The fearful bubonic plague is transmitted by fleas, and the deadly African sleeping sickness results from the bite of the Tsetse fly. Cockroaches, flies, fleas and mosquitoes make life miserable where they abound, and crops and cattle must be protected if mankind is to survive. So man commenced a relentless warfare upon the insects. Unfortunately, however, most human beings fail to distinguish insect friends from insect foes, although without their aid man and his crops would have been utterly

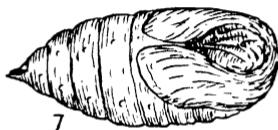
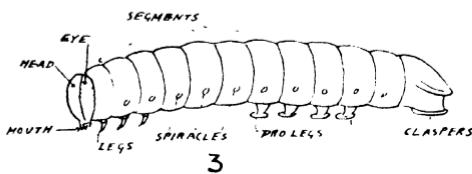
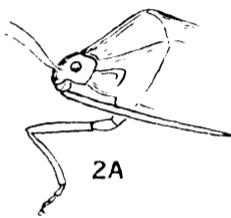
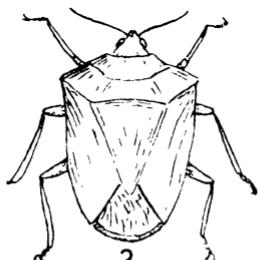
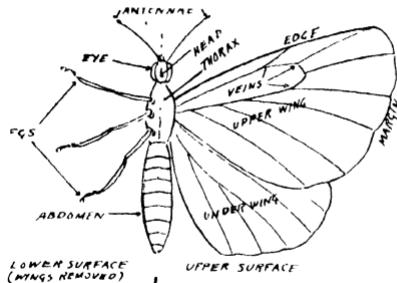
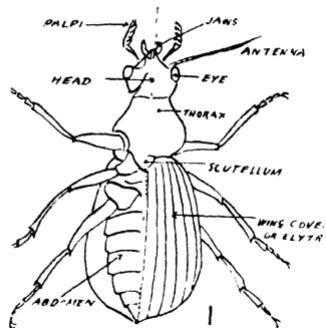
destroyed ages ago. In fact without certain insects human life could not survive. Were it not for bees, flies, moths and other insects which carry pollen from one flower to another many of our most valuable and essential seeds, nuts, fruits and grains could not be raised, for the flowers would not be fertilized and could not fruit or bear. Without certain useful and friendly insects there would be no silk, wax, honey, shellac or cochineal dye. Without ants and other ground dwelling insects the husbandman would find the earth so swarming with grubs and other insect foes that he could raise no crops, and yet when man took to poisoning insects and spraying trees and vegetation to destroy them wholesale, he began a war of utter extermination, killing his best friends as well as his worst enemies. Moreover, by doing so he unwittingly but none the less surely destroys countless birds most of which are his most useful allies in his warfare upon insects, for without insects many birds cannot live, and by devouring the poisoned insects and poisoned seeds and fruits the birds are killed. What will be the ultimate result is difficult to say. If by such spraying as is now being done the useful insects, the bees and flies and wasps, are destroyed, there will be none to fertilize the blossoms and there will be a greater dearth of many crops than if the injurious insects had wrought their havoc. Yet if the practice continues, it will not be long before we have a birdless and insectless world.

Although insects are the most ancient form of animal life upon the earth and swarmed in the warm and humid air that enveloped our planet long before there were quadrupeds, mammals or even reptiles upon the earth, yet among all the millions of kinds of insects man has never

found but two—the honey bee and the silkworm—which he could domesticate profitably.

Although both have been kept and reared by man for countless ages they have changed but very little from the original wild forms. There is no similarity between many of our common dogs and the original wolf or wolf-like creature which was their ancestor. Our horses bear little resemblance to the original wild horse from which they sprang, and no one knows with certainty the origin of our sheep, our cattle or even our cats and our poultry, but the most highly pedigreed Italian bee, the most prized of silk worms are still so much like the wild honey bee of the woodland and the wild silk worms of the Orient that to the ordinary every-day person they would be indistinguishable. Why, we may wonder, has man not been able to breed and rear these useful insects to the size their remote ancestors attained in past ages? During the carboniferous age, when the coal beds were being formed in the vast peat bogs of our land, dragon flies, cockroaches and other insects grew to gigantic size, often with a wing spread of two feet or more, so why should it not be possible to produce two foot honey bees or silk worms whose cocoons would weigh a pound or more? But probably it is fortunate that such creatures have not been produced. It would not be pleasant to meet an angry honey bee as big as a pigeon, and think what a job it would be to hive a swarm of bees of such size!

Although, as I have said, there are millions of kinds of insects and they vary tremendously in form, size and habits, yet all are alike in some respects. All true insects have six legs, all have their bodies divided into segments and all have jointed legs, antennae, well developed brains



1 Parts of insects 2 true insect 2A a bug proboscis 3 caterpillar 4 Sawfly larva 5 beetle larva 6 antennae of moth and butterfly 7 moth pupa 8 butterfly pupa

PLATE

and nervous systems and a circulatory blood system. And while all breathe air, they do not possess lungs or breathe through the mouth but instead are provided with openings called *spiracles* in the segments of the body whence the oxygen is carried directly to all portions of the body by means of tiny branching tubes known as *tracheae*. In their muscular construction the insects rank high, the muscular system being as delicate and complex as that of any form of animal, for even caterpillars which appear so jelly-like and flabby possess over 4000 distinct muscles. (Plate I)

Speaking of caterpillars, perhaps you think that I have made a mistake by stating that *all* insects have six jointed legs and segmented bodies, for surely, you say, you have seen caterpillars with at least twelve legs. But in that case it is you who are mistaken, for if you will examine any caterpillar carefully, you will find that the six forward legs are jointed while the others, whether they are two, four or six in number, are fleshy and similar to the rest of the body in their structure. These are not true legs but are merely temporary appendages which disappear in the adult insect, and are known as *prolegs* and *claspers*. If these are absent you may be sure the insect is not the caterpillar of a moth or butterfly but the larva of a sawfly or the grub of a beetle. Another fact of which many persons are unaware is that a great many insects do not pass through a caterpillar or a pupa stage with which we are all familiar in the case of moths and butterflies. The young or larvae of the crickets, grasshoppers and many other insects are scarcely distinguishable from the adult, while the pupa also resembles the fully grown insect and hops and moves about actively. The larvae or grubs of the cicada, or "locust," and the dragon flies are fearsome

looking creatures and form no true pupa stage, but after several changes of skin split open and the adult insect emerges. The oil beetles on the other hand have two or more larval forms as well as the pupal form, while the May-flies undergo still another stage between the time they issue from the pupa and the time when they appear as fully winged insects. Neither do all insects lay eggs. Some species have their young born alive while the aphids, or plant lice, sometimes lay eggs and sometimes give birth to their young, but strangest of all are those insects which produce their young while still in the larva or pupa stage of their existence.

To many persons any insect is a bug, but in reality a "bug" is only one of the many orders of insects and may always be recognized by its beak or proboscis with which it sucks the juices of plants or the blood of animals on which it feeds. It is much harder to distinguish a beetle with certainty, for while most beetles have hard shells there are many species with soft and delicate wing covers or without wings. Some of these resemble moths, others ants and others true bugs. All members of the fly family may be identified by having only two wings, while the wasps, hornets, bees and other stinging insects, including some which do not sting, have four wings. Moths and butterflies are usually recognizable, but the females of many moths are wingless and there are certain moths which closely resemble butterflies and fly about during the daytime, while there are true butterflies which have all the earmarks of moths. But there is one certain means of telling which is which, for all butterflies have slender antennae with a club like swelling at the tips while all moths have fern-like or feathered antennae. Even in the

chrysalis stage moths' chrysalids may be distinguished from those of butterflies, for while moths' pupae may be enclosed in cocoons or may be bare, the butterflies' caterpillars never spin cocoons and always suspend the chrysalis by means of silken bands attached to the tail or point of the pupa or supporting it like a girdle. But unless you study the insects closely and learn more of entomology, as the science of insects is called, you will find it a hard matter to recognize all the members of the order to which the cockroaches, katydids and many other insects belong, for there is very little resemblance between the katydid and a cockroach or a mantis. But even if you cannot tell to what order or group an insect belongs, regardless of whether it is a bug, a beetle, a moth, a butterfly or any other member of the insect world, you will find something of interest in its life and habits, while the stories of many are stranger and more remarkable than fairy tales. Even in fairy tales butterflies do not sing, yet there are Central American butterflies that make musical notes which are as much a "song" as that of the cricket or the grasshopper and are so loud that they may be heard at a distance of several yards. But even a singing butterfly is not so strange as some of the other insects.

CHAPTER II

INSECT ARTIZANS

DID you ever stop to wonder who were the first builders, the first carpenters and masons, who constructed comfortable snug homes of wood or brick? Not human beings of course, for beavers cut down trees and built their lodges, woodpeckers hollowed homes in tree trunks and the cliff swallows built their nests of sun dried clay ages before man abandoned a cave life. But long ages before the first beaver, the first swallow or the first bird or quadruped of any kind appeared on earth there were insect carpenters, masons and other artizans who felled trees, bored holes, sawed off limbs and made their homes of wood. There were masons who moulded mud and clay into tiny bricks and patiently constructed homes of adobe with partitions and rooms and galleries and even with hinged doors. There were paper makers who had learned how to transform wood fibers into a paper tougher and more durable than any made by man with all his intricate machinery, and who found paper homes more suited to their needs than those of wood or sun dried brick; and there were insects who constructed log houses as portable as our modern trailer camps. So we may be sure that the insects were the first of all artizans and the first of all builders.

Human craftsmen require tools and artificial aids to

enable them to work wood, make brick or paper and to dig shafts and galleries in the earth, but the insect artizans accomplish all their truly wonderful deeds with their own jaws and feet alone, and work today in exactly the same manner as did their ancestors millions of years ago.

Among the many insect carpenters the most skillful and the commonest are certain kinds of bees, and anyone who is interested can readily find and watch these winged carpenters at their work. You cannot fail to be interested when you discover what neat round holes these carpenters bore in hard wood and how accurately they cut and fit pieces with which to form partitions and line their homes, for the carpenter bees dwell in wooden houses cut from the heart of solid timber.

If you look carefully on the under sides of the rails of a rail fence, or on the under surface of the ledge of an old board fence, or even underneath the projecting beams or timbers of some old building, you will probably find one or more smooth round holes which look exactly as if they had been bored with an auger. You may see chips and sawdust on the ground beneath these holes, which indicates the carpenter's home is occupied, and if you place your ear close to the wood near the holes, you will probably hear a low buzzing sound from within, and will thus know that the carpenter is at home. If you wait patiently, or if you rap upon the timber, you will be rewarded by seeing a large black and yellow insect come tumbling out of the hole and flying angrily about.

"A bumblebee!" you will exclaim, and no doubt you will wonder what it is doing in this hole. But in this surmise you will be mistaken for while the bee does look

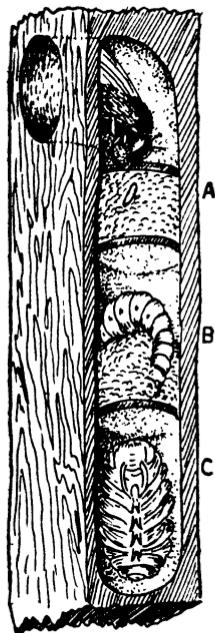
much like a bumblebee at first sight, the owner of the hole in the fence is really quite different, as you would discover were you to place it side by side with a real bumblebee.

This insect is the large Carpenter bee, and no human carpenter with the finest of steel tools can bore neater holes or chisel out solid wood better than does this insect with its sharp horny jaws. Having selected a suitable spot the bee begins to bore a circular doorway and having reached a depth of about an inch it turns at right angles to the entrance and patiently cuts out a cylindrical tunnel a foot or more in length parallel to the surface of the wood and running with the grain, for the winged carpenter knows enough to work *with* the grain and not against it. This of course requires hard, unceasing labor for several weeks, for the creature's jaws, sharp and busy as they are, can bite away only a minute quantity of wood at a time. From dawn until dark the bee works away until at last the smoothly bored tunnel is completed and business can be combined with pleasure by frequent excursions to obtain honey and pollen from attractive flowers. Very often you may have seen these bees buzzing about in the fields of clover or about a garden, and unless you are a keen observer or an entomologist you have thought them only common bumblebees.

The nectar obtained is formed into a paste which is packed in the bottom of the hole, and on this an egg is laid. Now the busy carpenter brings tiny chips and builds a neat partition or wall across the tunnel thus shutting off the egg and its honey paste. More nectar is packed over the wall and another egg deposited, another partition is built over this, and the operation is repeated again and again until the snug dry home is completely filled with

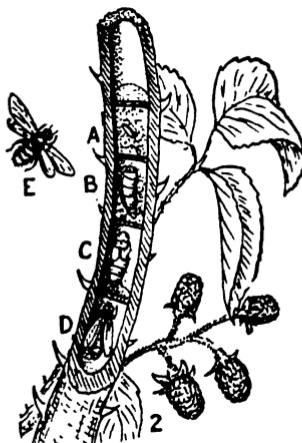
little cells, each containing an egg and a store of food for the young bees when they hatch out, (Fig. 1).

In due time the first egg that was laid hatches into a tiny white grub which at once commences to devour the honey its parent has placed there. Then when at last its little stomach is full, it curls up and goes to sleep and as it



slumbers, its skin becomes hard and brown while in the other rooms its brothers and sisters are hatching out and dining on their stores of honey and dropping off to sleep in turn. At last the little brown pupa at the end of the tunnel bursts open and a perfect bee comes forth, only to find its way barred by the wooden wall its mother built. Its jaws even if newly formed are strong and sharp, however,

and it rapidly eats away the partition only to discover its nearest brother or sister still asleep in its pupa. As there is no space for it to pass, the little bee must wait until the other member of the brood wakes up as a bee, when the two tear down the next wall only to find still another pupa sound asleep. Again the two must wait until the third youngster wakes up and if there is a fourth cell all three must remain prisoners until the last pupa hatches. Then,



breaking down the last barrier, the whole brood swarms forth to try their gauzy wings in the summer sunshine and to feast on the flowers until it is time to commence building wooden homes for their own young.*

* According to some writers the carpenter bee provides a rear exit for the young by leaving only a thin partition of wood between its tunnel and the surface at the lower end of its hole. In this way the first young bee can emerge from its cell without waiting for the others, and those which follow thus have a clear road to the open air. Personally I have never observed this and Comstock and other entomologists do not mention it but agree with the description I have given.

This big black and yellow carpenter is only one of a number of our common carpenter bees, and while the largest of our northern bee carpenters, it is a pygmy compared to some of the huge tropical species which bore holes over an inch in diameter and excavate tunnels nearly a yard in length in the hardest woods. Others of our Carpenter bees dig their tunnels in the branches of trees or in the stems of shrubs, vines and flowers, for some are very tiny insects smaller than a common housefly. One of the handsomest is a little metallic emerald-green bee which makes its home in the stalks of blackberry vines and elder bushes, (Fig. 2), and sometimes proves a great nuisance by killing the berry bushes with its tunnels. But the most interesting of all these bee carpenters is the Leaf-cutting bee, a pretty insect closely resembling the common honey bee but easily recognized by its stout orange-red hind legs and the metallic green reflections about its head, (Fig. 9, Frontispiece).

You can always know when these insects are about, for they make their presence known only too plainly by neat round or oblong holes cut in the leaves of rose bushes or even in the petals of the roses themselves. While these mutilated leaves are far too common and are the despair of gardeners, yet the nests for which they were cut are seldom seen, for this carpenter hides its snug home deep in the heart of some fence post or timber well out of sight. Unlike the big carpenter bee already described, the leaf cutter makes its hole straight into the wood. Then, when the hole is deep enough to suit its owner, the leaf cutter visits the nearest rose bush and clips out a neat oblong piece of tender leaf. Over and over again she uses her scissors-like jaws, (Fig. 3A), to snip pieces from the

leaves and, more skillful than any human artizan she cuts each piece of a certain size and form to exactly serve the purpose for which it is intended. Carrying the pieces of leaf to her hole, the bee forms them into a thimble-shaped tube at the bottom of the tunnel, and there her clever engineering skill is demonstrated, for so accurately are the pieces cut, with some oval, others oblong and slightly wider at the ends than in the middle, that when placed in proper order in the tunnel, they fit perfectly and form a tube as smooth and tight as if moulded from wax, (Fig. 3). As soon as the leaf tube is completed it is filled with



pollen and honey and an egg is laid in the mass. Again the bee makes trips to the rose bushes but this time the busy creature cuts perfectly circular pieces just a trifle larger than the diameter of her hole. These she pushes into the upper end of the leaf tube she has made, and with them she forms a tightly fitting stopper. These operations are repeated again and again, until the hole is completely filled with the little capsules each with its egg and larder. The lowest eggs hatch out first and each of the young bees waits patiently for the one ahead to emerge in the same way as the young carpenter bees already described. Although the rose leaf cutters are the commonest of this

group of bees, there are many species with similar habits. Each appears to prefer the leaves of some certain tree or shrub, and some are most dainty in their choice and use only the bright hued petals of pansies, petunias and other flowers for constructing their youngsters' nurseries. Neither do all the leaf cutters bore homes in solid wood. Quite frequently they use a hollow twig or branch or even a knot hole or a space beneath a shingle or a clapboard, and being adaptable creatures they even make use of hollow awning rods or water pipes instead of boring tunnels for themselves.

Perhaps during your rambles, you may have noticed some clay or sandbank that was riddled with small holes looking as if a charge of buckshot had been fired at it. And if so you have doubtless wondered why anyone should use the bank for a target or what caused the innumerable holes.

Unless you dug them out very carefully, or happened to find them while they were being made, you would never guess the answer, for these are the entrances to the underground homes of Mining bees. Some of the bee miners are as large as honey bees while others are the smallest of the bee family and are less than a quarter of an inch in length, but all have much the same habits. Like human miners who timber their tunnels and shafts as they dig, the mining bees prevent their workings from caving in by lining them with a secretion which forms a strong glaze like that on earthen ware. Unlike the tunnels of the carpenter bees, those of the miners are provided with side tunnels or rooms in each of which the mother bee lays an egg and stores honey and pollen for her young. Moreover, the miners are sociable insects and prefer to be neighborly

rather than solitary, and quite often there will be thousands of the burrows forming a real mining town in a few square yards of a bank.

Interesting as are the insect carpenters, the insect masons and paper makers are even more remarkable in their craftsmanship and their house building. In nearly every old barn or shed, in many an attic and under many a bridge you will find the irregular hardened clay homes of the Mud-dauber wasps, (Fig. 4). These common deep



blue insects are true masons and even though their homes are ugly and more or less shapeless on the outside they are most cleverly arranged within, with cylindrical galleries and tiny rooms neatly lined with a tough glaze and providing snug and safe quarters for the baby wasps. Unlike the bees which feed upon pollen and honey, the wasps are carnivorous creatures and a supply of meat must be provided for the young wasps when they hatch from the eggs in their brick cells. There is a problem of how to store away meat so that it will not spoil, for of course the wasps cannot provide refrigeration to preserve the food until their youngsters need it. But Nature has given the wasps a means of preserving meat which is far better than any method ever devised by man. When the wasp's home is completed, she goes on a hunting trip and soon finds a nice

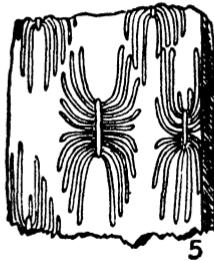
fat spider waiting for some unwary fly to blunder into its web. Like an eagle attacking a wolf, the wasp swoops down, in a flash she seizes the spider in her jaws and feet and plunges her sting into her victim's body. But she is very careful as to just how and where she stings the spider, for she has no desire to kill the creature. Instead, she uses her sting like a hypodermic needle and injects just enough poison to put the poor spider to sleep, but a sleep from which it will never awaken. Having anaesthetised the spider the wasp flies with him to her mud home, and placing the unconscious creature in one of the cells, deposits an egg and closes the door with mud and glaze. There, thoroughly alive but paralyzed and unable to move, the unfortunate spider will remain until the egg of the wasp hatches out and the grub dines upon the still living flesh of the spider placed there by the mother wasp.

Although spiders are the favorite food of our common mud-daubing wasps, there are other wasp masons which capture caterpillars and sting them into a comatose state to provide food for their young, while still others use grasshoppers or other insects, some species even being true cannibals and capturing other species of wasps, hornets or bees.

Each species also builds its own particular form of mud house, the most interesting and remarkable of all being the beautifully moulded homes of the little Potter wasps. These clever insects are not only masons but are true potters as their name implies, and model rounded symmetrical earthenware pots with narrow necks and flanged mouths to serve as homes for their young, (Fig. 3 Frontispiece). You may often find these little pot-bellied jars attached to the stems of plants or bushes, and if you did not

know what they were, you might well think that they were the earthenware pots of fairies or brownies or other pygmy people of the woods and fields.

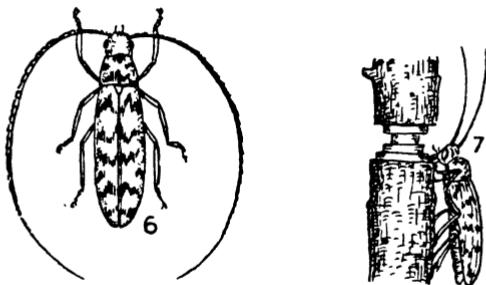
Although the most skillful insect carpenters and masons are found among the bees and wasps, and while the only paper makers are the hornets who transform bits of wood to the tough gray paper of which the common hornets' nests are made, there are many other forms of insects who are accomplished wood workers, and among the beetles there are not only borers that penetrate the hardest and toughest of woods, but wood carvers who engrave intricate



designs and patterns, as well as lumbermen who actually fell trees. To be sure, the little Wood Engraving beetles do not produce their carvings because of an artistic talent, but merely by tunnelling a labyrinth of burrows between the bark and the wood of trees. But the results are often as attractive and as symmetrical as though intended for a true design, (Fig. 5). And they are even more destructive than the Lumbermen beetles which fell trees and lop off branches intentionally and go about their tasks with a fixed purpose and a determination that is truly amazing, and as if their lives depended upon the results. In a way they do, for the young of these lumbermen beetles must

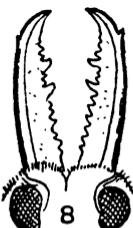
have dead wood in which to live until they reach maturity, and their parents provide it, although it would seem as if there was dead wood and to spare without the need of killing living trees to supply more.

The commonest and most destructive of these beetles are the Timermen, the Girdlers and the Sawyer beetles. All of these are rather long and slender beetles with very long antennae, sometimes several times the length of the body, (Fig. 6). Some are dull colored and some are handsomely marked with yellow and black, brown and



white or other tints, and all are among the most destructive of insects. The girdlers lay their eggs in twigs and then cut complete girdles about the twig below the egg, (Fig. 7). This kills the twig which eventually withers and drops to the earth where the girdler's larva issues from the wood and burrows into the ground to transform to a pupa. The sawyers and timbermen fell their trees in a very different manner, for they bore deep into the wood, riddling it with their burrows until at last the tree is killed and falls crashing to the earth. It seems strange indeed that little beetles only an inch or two in length should have the power of destroying mighty trees and whole areas of

forests, and it is fortunate that these insect lumbermen of the north are no larger than they are. But in tropical lands, as in Central and South America, there are sawyer beetles of immense size, some over six inches in length, which fell the largest of the great trees in the jungles. And if we examine the jaws of our common sawyer beetles we will find them as well designed for their purpose as any steel saws made by man, (Fig. 8).



Finally there are the funny insects which build portable log cabins. These are the caterpillars of moths and if you search carefully on cedars or other evergreen trees, and on osage orange and other ornamental trees and shrubs, you may discover some of the queer chaps. But you will need sharp eyes and patience, for unless the occupant is on the move, you will mistake his log house for a little bunch of dead twigs caught in an old spider web. There are many species of these Bag worms or Basket worms as they are called. Some are tiny fellows and have portable homes made of minute bits of the twigs of the plant on which they feed, while others are sizable chaps and have houses three or four inches long built of twigs an inch or so in length. But in every case the miniature log cabin is composed of tough silk to which the twigs are attached, and the little occupant dwells within holding it in place with

his hind legs or claspers and moving about by means of his six true legs near his head, (Fig. 9). When he wishes to remain in one spot for a time, or is hungry and wants to dine, he moors his home with a thread of silk and if frightened or molested he draws quickly into his cabin, pulls the silken door closed behind him and feels perfectly safe. When at last he is fully grown and is ready to change into a chrysalis he doesn't have to bother making a cocoon like



other moth caterpillars, for the log cabin which has served as a camp throughout his caterpillar days makes an excellent cocoon, and fastening it to some convenient branch by strong silken strands, he spins silk across the opening, curls down inside and changes to a pupa, to emerge a few weeks later as a winged moth. The female, however, is wingless and never comes forth, but remains within the bag where she lays her eggs and dies and the little log house becomes her tomb.

In Ceylon the people believe that these bag worms, which attain a much larger size than ours, are reincarnated human beings who stole wood during their former lives and are compelled to atone for their sins by crawling about in the form of worms forever carrying a load of wood on their backs.

Although most of our bag worms make their ambulatory houses of bits of leaves or twigs there are certain species which build even more wonderful houses. These are the larvae of the Psyche moths and instead of spinning a bag of silk and covering it with shingles of sticks or trash, these clever fellows spin a silken house which is so exactly like a snail shell that they are often mistaken for genuine shells, (Fig. 10).



Although you might never guess it, these interesting insects are very near relatives of our common clothes moths, and if you are so unfortunate as to be a victim of these household pests and will examine cloth they infest, you will find that they, too, make little traveling homes using tiny shreds of cloth or lint in place of sticks or twigs.

CHAPTER III

INSECT OGRES

THE next time you are walking along some sandy country roadside on a summer's day, look closely in the spots where the sun shines brightest and hottest, and you will probably see a number of curious little funnel-shaped pits a few inches in diameter. If you examine these more closely you will detect two tiny, motionless, dark colored pointed objects protruding very slightly from the sand at the bottom of the steep sided pit, (Fig. 11). Do not dis-

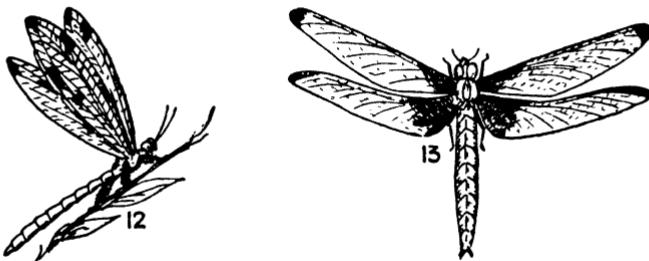


turb these by attempting to investigate but wait patiently and you will soon be rewarded. Presently, as you watch, a little ant will come scurrying along all unmindful of the fact that a terrible ogre is lurking near. But as she reaches the edge of the miniature pit the sand slips suddenly from beneath her feet. Bravely she strives to regain the edge but as she scrambles upward the sand seems pulled from under her, and although she struggles with all the strength of her six legs, she slips to the bottom of the pit. Instantly the two tiny points dart forth, and seizing the ant in a vise-

like grip, mercilessly tear her to pieces before your surprised eyes. And now you realize that the apparently harmless little points are the jaws of the ferocious little creature known as the Ant Lion, and a far more terrible and relentless enemy to the ants than any real lion to man. If you unearth an ant lion from its cleverly planned pitfall, you will find him a most curious and active little beast, with a fat broad body, a humped back and a large flattened head equipped with a pair of huge, strong curved jaws, (Fig. 11A). But you must work rapidly and must watch sharply if you wish to capture the little fellow, for he can dig swiftly into the sand when alarmed, and his body with its short stiff hairs is so much like the sand in color that he is difficult to detect. He is a very queer insect and moves backward as well or even better than forward, and in this manner can move with surprising speed. And the moment he is free he will begin digging a new pitfall by throwing up the sand with his head and jaws, using them exactly like a shovel until the conical pit is completed and he vanishes from sight and remains motionless, awaiting the arrival of another victim.

The ant lion, however, does not spend all of his life digging pitfalls and dining on unfortunate ants and other insects which drop into his trap and his hungry jaws. When he is fully grown, he spins a silken ball covered with grains of sand and within this cocoon he changes to a pupa. In a few weeks the pupa bursts open, and gnawing its way through the cocoon the adult ant lion comes forth. But you would never recognize him, for he is now a winged insect with a long slender body, really handsome in his new dress of metallic blue, and much like a small dragon fly or "darning needle" in appearance, (Fig. 12).

The Dragon fly, however, is not a near relative of the ant lion, but he is an even more terrible ogre of the insect world, although harmless to human beings despite the old fashioned and ridiculous belief of ignorant people that these insects sew up persons' ears. In fact, the dragon flies or "darning needles" are among the most useful of all man's insect friends, for they devour countless thousands of flies, mosquitoes, midges, gnats and other noxious insects. It is no wonder that they are terrible ogres to their fellow insects, for their long strong wings enable them to overtake the swiftest of their prey, their great staring bold



eyes gaze in every direction at once, while their powerful, keen jaws are designed by Nature for seizing and rending their victims, (Fig. 13). In their adult winged stage the dragon flies are savage bloodthirsty creatures of the insect world, but in some ways they are even more fearsome ogres during their young or larval stage when they dwell beneath the surface of the water of ponds, lakes and streams. The mother dragon fly lays her eggs in the water or on the stem of some plant near by, and as soon as the young hatch out, they swim off and dive to the bottom where they lurk among the muck and water weeds and prey upon any living creatures they can overpower and

kill. They are strange looking little beasts at this stage of their existence, (Fig. 14), not in the least like the fully grown, swift winged, long bodied, brightly colored "darning needles" that flash in the sunshine above the fields and roadsides, and if viewed through a powerful lens, they are as fearsome and terrifying in appearance as any ogres of fairy tales. Largely their grotesque and ogreish looks are due to the lower lip which is a most remarkable and curious organ. When folded up and not in use it completely covers the creatures' face like a mask, (Fig. 15). But it is



long and flexible and armed with strong sharp jaws, (Fig. 15A). With it the dragon fly larvae, or "nymphs" as they are called, capture their prey, using the lip like a harpoon and rarely missing their mark. At last, when fully grown, the ugly nymphs crawl out of the water, attach their claws firmly to the stem of some plant or to the bark of a tree, and split open along the back whence the winged insect emerges, leaving the old skin empty, but still perfect in form clinging to its support.

Still another insect which is a real ogre in the insect world, is the Mantis, (Fig. 16). Most persons are more or less familiar with this strange and useful little creature, for within the past few years it has become something

of a tad to keep living mantes as pets. While the species found in the northern states are small and far from conspicuous, numbers of the big southern and tropical species of mantis have been introduced by way of trucks of oranges and other produce, and by automobiles until now it is not unusual to find a mantis four or five inches in length wandering about the streets of New York or seeking its prey amid the foliage of the New England wood-



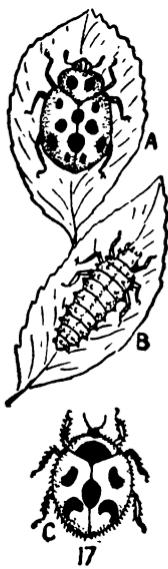
land. What terror the arrival of such a creature must cause the other insect denizens of our fields and forests! A gigantic and ferocious dinosaur suddenly appearing in our midst would be no more terrible to us humans than a big tropical mantis to our northern insects. In fact, it would be far less of a calamity, for poison gas and artillery would soon put an end to the dinosaur ogre while the poor insects are helpless against the ferocious mantis ogre. To mankind, however, the mantis is a real friend and ally, for the creature destroys vast numbers of injurious insects and is

always hungry, with an appetite that never can be satisfied. Like many another insect the mantis is known by many names such as Camel Cricket, Rear Horse, Devil's Coach Horse and Praying Mantis, the last because of the attitude of the insect's front feet, but "preying" mantis would be far more appropriate, for they are most ferocious insects and thorough hypocrites as well. Their eyes always wear a most mild and innocent expression and their front feet raised as if in prayer or supplication, are in reality merely poised in readiness to seize any insect they may meet. Butterflies and moths are favorite tidbits for the mantis, but the creature's whole existence is one continual slaughter, and it makes little difference what his victims are. He even adds cannibalism to his crimes and does not hesitate to kill and devour another mantis smaller or a poorer fighter than himself.

The eggs of the mantis are laid in curious oblong clusters protected by a hard horny covering arranged in such a way that it gives the bunches of eggs the appearance of being braided, (Fig. 16A). Unlike many insects which pass through various forms or stages before reaching maturity, the young mantis differ very slightly from their parents to whose insatiable appetites and insane ferocity they frequently fall victims.

Although the mantis and the dragon flies are big powerful insects, and it does not seem so strange that they should be true ogres of the insect world, many of the most bloodthirsty and terrible of insect ogres are small and harmless appearing creatures. Among these are the common and familiar Lady birds or Lady beetles, (Fig. 17A). Always recognizable by their roundish form and spotted backs, the lady beetles may be found nearly every-

where and on almost all plants. There are many species, some minute insects, others a quarter of an inch or more in length, and they vary greatly in color. Some are black spotted with red, white or yellow, others are dark blue or rich brown with lighter colored spots, while the majority are yellow, orange or red with black, yellow or even white spots. Unlike most insects which are wary and afraid of



man, the lady beetles are confiding little things and seemingly think that as they are friends of man, human beings are their friends. But their confidence is all too often misplaced, for as they are usually found on or near leaves of plants which have been injured or eaten, most persons think they are the offenders and destroy them. In so doing they kill their greatest allies, for the lady beetles and their young are ferocious ogres to the plant lice or aphids, the

scale insects and thrips, and to young caterpillars, and the injuries to the plants which are ignorantly attributed to lady beetles are really the work of insects which these beetles destroy. Usually, when a lady beetle is found on an injured plant, she is eating the real miscreants or is about to deposit her eggs knowing that her youngsters will thus be sure of a supply of food when they hatch out. No one can estimate how many millions of plant lice and scale insects the lady beetles destroy every year or how many millions of dollars worth of crops would be destroyed were it not for these pretty little beetles. But we do know that the citrus fruit industry of California was made possible by a species of lady beetle and that had it not been for these little insects there would be no oranges, lemons or grape fruit raised in California—or anywhere else in the United States probably—today.

When the Cottony-cushion scale insect was accidentally introduced into California, this most terrible and destructive of insect enemies of the citrus fruit growers increased with amazing rapidity, for in their new home there were no natural enemies to keep them in check. In an incredibly short time they had spread to every orchard and every orange tree in California, and the growers became terrified. Nothing checked the scales' increase and destructiveness, and realizing that they were at the mercy of the new insect pest, the fruit growers appealed to the United States Department of Agriculture for help.

As the government entomologists knew that in its native home in Australia the cottony scale caused little or no damage to the citrus trees, they reasoned that there must be some natural enemy of the insect which kept it in check in its native land. So a scientist was despatched to far-off

Australia to discover the scale insects' enemies. He had not long to search. Almost immediately he found a pretty red and black lady bird known as the Vedalia, (Fig. 17C), whose larvae possessed insatiable appetites for the scale insects which were rapidly destroying the orange groves of California. Quickly a number of captive vedalia lady beetles were packed in little boxes and shipped to California where they were released in the orange groves. Famished after their long journey, the beetles fell upon the nearest scale insects like hungry wolves, and having gorged themselves the females began laying eggs. As each female laid approximately 300 eggs, it was estimated that if all went well and the Vedalias multiplied as fast as they should, a single mother lady beetle would have seventy-five billion descendants within six months. But any one or more of many circumstances might arise to upset the scientists' well laid plans and leave the orange growers as badly off as ever. The vedalias might be destroyed by some new enemy faster than they could breed. They might find some other insect pest more to their taste than the scales they were expected to destroy. They might scatter far and wide over the land and not concentrate upon the California orange groves, or there might be something in the climate that did not agree with them and they might not survive. For a space the scientists and the fruit growers figuratively held their breaths and there was a period of anxious watchful waiting. But there was no cause for worry, the imported lady beetles thrived and bred, and they increased even more rapidly than the scientists had expected. They appeared to be free from all enemies and, best of all, they ate only the cottony-cushion scales. Just as our own American lady beetles turned up

their little noses at the imported scale insects and dined only upon those of their native land, so the vedalias demanded only the Australian cottony scale for their bill of fare and would go hungry or even starve to death before they would dine on American scale insects. And as long as there was a cottony-cushion scale to be found they showed no signs of restlessness or a desire to seek new fields or scenes.

Science plus the vedalia lady beetles had conquered. In six months the Australian lady beetles had spread all over southern California and had made such inroads upon the scale army that the withered dying orange trees put forth new leaves and began to bloom once more, and within a single year after the first vedalias had arrived, the scale insects were under control, all danger to the groves was over, and the orange growers breathed freely once again.

Meanwhile the news of the successful experiment had reached other lands where the destructive scale had found a foothold and from far and near requests for vedalia beetles came to our government. As a result, the State of California maintains a barracks for its lady beetle militia, with its insect regiments at full strength, in the best of fighting trim and ready for active service wherever they are needed. Like the Marines, they are the "first to fight" wherever and whenever the enemy appears, and like the "soldiers of the sea" they are sent post haste by land or ship to the scene of trouble. Already their ranks have done service in the South Pacific islands, in Hawaii and on the sunny shores of the Mediterranean, and as long as there are vedalia lady beetles orange growers have no

cause to fear the deadliest enemy of their trees and orchards.

To the tiny scale insects and the aphids the lady beetles must appear like great armored tanks. Ponderous, irresistible things mowing them down with terrible jaws, crushing them underfoot like an elephant in a poultry yard. But fearsome and deadly as is the lady beetle its larva is a thousand times worse from the aphids' and scale insects' point of view. If the adult, hard shelled creature appears to them as an animated, man-eating tank would appear to us, then surely the creature's larva must seem like a veritable dragon, a bone crushing, bloodthirsty monster with sickle-like slathering jaws, a demon whose one instinct is to kill and devour. But to us the young lady beetles are merely insignificant creatures, flat-bodied and wingless, with short legs and big heads and not in the least resembling their parents, (Fig. 17B), but far more like the ant lions in appearance.

Appearances, however, are often most deceitful. The worst of human gangsters and murderers often look like pleasant gentlemanly fellows, and it is the same in the insect world where oftentimes the most bloodthirsty of insect ogres appear most meek, mild and harmless creatures. Such is the case with a lovely little insect which may often be seen in gardens, as well as in fields, and on summer evenings flutters about the lights in our houses. Dainty and frail with filmy pale-green wings, a slender green body and long graceful antennae, the almost fairy-like creature may always be recognized by its great lustrous, luminous eyes which gleam like gold one moment or glow like living coals the next. In fact, the insect is known as

the Golden Eyes or Lace Wing fly, either name being most appropriate, (Fig. 18A).

But who would ever dream that this dainty, lovely, frail little creature leads a dual life, a real Doctor Jekyll and Mr. Hyde existence, and in its youth is a ferocious, blood-thirsty ogre of the insect world, as terrible an enemy to the aphids as the lady beetle, and hence another of mankind's firmest insect friends?



Neither would you ever guess that the little orange and black creatures with strong curved jaws, which you may find on rose bushes, willows and other trees, and which look like miniature ant lions or a bit like the larvae of lady beetles, are really the young of the beautiful golden eyes, (Fig. 18B). Hungry and bloodthirsty, incredibly strong for their size, and absolutely fearless, these *Aphis* Lions, as they are called, will boldly attack and devour insects several times their own size. They are true Jack-the-Giant-killers of the insect world, for the moment they have hatched from the egg they will fall upon the first

aphis or other insect they meet and with indescribable ferocity will fight and struggle with the giant until at last it is overcome and the bold victor can dine upon the victim's blood. One species of these creatures, known as *Hemero-bius*, not only devours the aphids, but fastens their empty skins to bristles on his body and goes about with his back covered with the trophies, like an Indian warrior with his scalps, (Fig. 18E). There are few if any living creatures as voracious as these little insects whose appetites are never satisfied. Even a newly hatched aphis lion will kill and devour two or three aphids in an hour. At ten days of age it will destroy at least one every minute, while two days later its ever increasing appetite and strength will result in the destruction of an aphis every half minute. But at twelve days of age the creature's life as an ogre is at an end. Rolling itself in a little silken ball, which glistens like a shimmering pearl upon the leaf to which it is attached, the well fed aphis lion changes to a pupa, (Fig. 18C). A few days later a tiny circular lid opens in the cocoon and the fairy-like golden eye insect emerges. Apparently, during its long sleep, the lovely creature has been reformed as well as transformed, for it shows no signs of its former murderous propensities and is seemingly a most defenceless insect. But in reality it possesses a most effective means of protection for, lovely and delicate as it is, it emits an odor so vile that no insect or bird enemy will molest it, and which is almost as difficult to eradicate as the odor of a skunk. But the most remarkable habit of the golden eyes is the manner in which she lays her eggs. Even if she is no longer a bloodthirsty and carnivorous creature herself, she may remember her youthful ways, and she seems to know that her offspring must

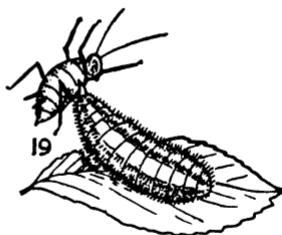
be protected from the hungry jaws of one another. At all events, she does protect them by placing her eggs at the tops of stiff silken stems half an inch in length, which look like fine silver pins stuck into the surface of a leaf, (Fig. 18D). Then, when the first of the young hatch out, they scramble down the egg stalks and scamper off in search of aphids without knowing that their brothers and sisters are still resting safely within the eggs high above their heads.

No doubt you have noticed the bright colored flies which hover in the air so seemingly motionless in one certain spot that they might be suspended by invisible wires. Strange creatures, with most amazing powers of flight to be thus able to remain poised as if fixed in mid air, these Hover flies, as they are called, are still another of the ogres which make life miserable and existence most precarious for countless insect enemies of man. Not only do the adult flies prey upon other insects but in their larva or grub stage they are such savage and bloodthirsty creatures that they may well be called *Aphis Wolves*. And although they are blind and legless they destroy fully as many aphids and other injurious insects as do the *aphis lions* which are furnished with excellent eyes and strong and useful legs to aid them.

Of all living creatures the insects are the strongest in proportion to their size, and the little maggot-like, helpless looking larva of the hover fly is probably the strongest of them all. To watch one of the tiny grubs, barely one-sixteenth of an inch in length, attacking an insect more than twice its size cannot fail to arouse one's interest and wonder. Blind as it is, the grub seems to know instinctively when near its prey, and wriggling towards it with surprising speed, using the rough edges of its skin as a

means of locomotion, the young fly seizes the aphis or other insect in its jaws. Then, despite the frantic struggles of its captive whose weight is greater than its own, the grub rears itself on its tail and holding the fighting victim aloft sucks the juices from its living body, (Fig. 19).

Truly, such a ferocious and powerful creature may well be considered an insect ogre, yet there are still other insects which are even more dreaded, more terrible, and more cruel and pitiless to their fellow insects than any of the insect ogres I have mentioned. These are the Ichneu-



mon flies. Often they are mistaken for wasps, others look more like hornets and many are scarcely distinguishable from flies. But all have similar habits and all are firm friends of mankind and perhaps do more to check the spread and increase of injurious insects than any other creatures.

Although many of these ichneumon flies are so wasp-like and dangerous in their appearance, (Fig. 20), only a few species are capable of stinging human beings, and these only do so in self defence when captured. In fact, they do not possess true stings like those of the hornets, wasps and bees, the sting-like organ at the extremity of

the body being a sharp tube or ovipositor by means of which the eggs are laid. Searching about until it discovers some caterpillar, the ichneumon pounces upon it and, clinging to the unfortunate victim, pierces its skin with the sharp sting-like tube and deposits an egg in the caterpillar's body. Some species lay only a single egg in each victim, while other species may deposit a number at a time. In either case, however, the eggs hatch out and the grubs of the parasitic fly eat the living tissues of the caterpillar but avoid vital organs until they are fully grown when they change to pupae. Some species form their pupae within their victim's body and do not emerge as winged insects until the doomed caterpillar has transformed to a chrysalis, while others make their way to the surface of the caterpillar's skin and form their cocoons on the outside of its body. But always the result is the same. The caterpillar which has served as a living larder for the young ichneumons shrivels and dies. No grub or caterpillar is safe from these fearsome insect ogres. It makes no difference whether they are armed with stinging poisonous spines or are covered with thick hair. They may hide themselves within rolled up leaves or burrow deep within the wood and bark of trees, yet the Ichneumon flies will doom them to a slow and awful death once it finds them, for there are ichneumons fitted by Nature to prey upon nearly every form of larvae even including those of wood boring insects. The ichneumons which seek these out are provided with immensely long, flexible ovipositors, scarcely as thick as a horse hair, which may be thrust deep within the burrows of their victims to deposit the ogre's eggs in the bodies of the helpless borers.

All this may seem very cold blooded and needlessly

cruel to us, but the insect world is a cruel and cold blooded world. Always, from the egg to the adult stage insects' lives are constantly in danger. It is ever a case of eat before you are eaten. But it is very doubtful if any insects can feel pain as we understand it, and they certainly do not suffer from mental anguish, which after all is the greatest of all agony, so we need not waste our sympathies upon them though we should be ever thankful that Nature did not create these insect ogres to prey upon man.

What a terrible thing it would be if dragon flies were as large as eagles; if mantes the size of wolves infested the forests; if creatures as big as bears and with the strength and ferocity of aphis lions existed; or if ichneumon flies spreading six feet across their wings hovered in the air ready to swoop down and deposit their eggs within our bodies!

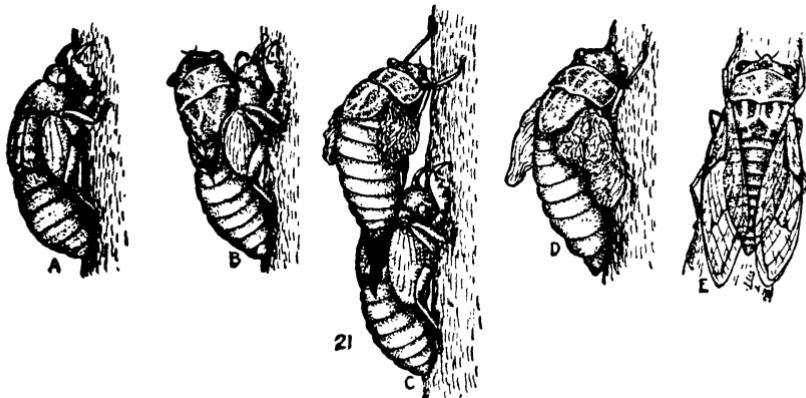
CHAPTER IV

THE LIFE OF THE LOCUST

THE incisive song of the locust, issuing from the foliage of the trees on a hot mid-summer's day, is one of the most familiar of insect notes. Yet few persons know what an interesting creature the singer is or are aware that it is not really a locust, but a Cicada, and a member of an entirely different order from the true locusts. The latter, which have proved a greater scourge to mankind than any other one insect, are true grasshoppers, while the cicada, which is commonly called a "locust" and also is known as the "harvest fly", is closely related to the tiny aphids or plant-lice. To be sure there seems little resemblance between the big, gauzy winged cicada and a tiny aphid, but if we examine them closely, we will find that the differences are largely those of size. Both have bodies much alike in form and structure and both possess tubular snout-like mouths adapted for sucking the juices of the plants on which they feed, while the true locusts or grasshoppers have mouths with sharp cutting jaws designed for devouring herbage and foliage.

Like nearly all well-regulated members of the insect world, the cicada begins its existence within an egg, which in the case of the cicada is deposited in a tiny slit made by the female insect in twigs or fruit. As soon as it is hatched the little grub finds its way earthward and industriously sets to work to bury his naked body underground. There,

in his self-made subterranean home the young cicada spends the winter months feeding upon the sap of nearby roots and steadily growing larger, until by spring he is a good sized, fat bodied, ugly looking creature. Even when warm weather arrives and other cicadas sing gaily from the trees, the grub or "nymph" remains underground, daily increasing in size and strength until a second winter has come and gone. Then a strange restlessness possesses



him, and as if suddenly remembering that there is a sunny warm world somewhere above his tomb-like home, he burrows upward, until at last he emerges from his long retirement on some warm, moist August morning.

But you would never recognize him as the offspring of a cicada. A rough, horny, earth colored creature he is, with strong hooked feet and bulky body, (Fig. 21A). Clumsy he is also, and staggering along, he gropes blindly about for some perpendicular object up which he laboriously begins to climb. But before he has traveled far he halts, and digging his strong claws into the surface of the

tree or fence post, he anchors himself firmly to his support. For a space he remains motionless. Then a slight quiver shakes his dull brown body and a tiny crack appears upon his back. It seems almost as though his unusual exertions actually had burst his horny shell as the gaping wound opens and reveals a mass of damp, pulpy material within. Slowly the split widens and a broad and massive head, bearing two shining eyes, pushes through the opening, and we realize that a most wonderful transformation is taking place, (Fig. 21B).

Slowly and steadily the head slips forth and we notice that between the two large eyes there is a group of smaller eyes which gleam and scintillate with a golden luster as if glowing with delight at their first glimpse of the world of sunshine. Presently the entire head projects from the slit. With a smooth gliding motion the thorax follows, and then the first pair of legs are drawn forth and waver feebly about searching for some foothold, (Fig. 21C). An instant later the wings appear, tiny, wrinkled, pulpy mats of dull green, folded closely against the body. By now fully one half of the new born cicada is free of the old shell and yet the soft and flimsy legs have not found a support and the entire weight of the creature is held by the dry pupa case still adhering by its now lifeless claws, (Fig. 21D).

Slowly and cautiously the tender pulpy insect bends forward towards the tree or post, feeling carefully with its little legs, until at last the claws grasp the surface. Then for a moment the insect remains motionless, gathering all its strength for a final supreme effort, and then, exerting all the power of its newly formed muscles, it tugs, pulls and strains.

At last it is almost free. Only a scant quarter of an inch

of its body remains within the wrinkled shell that for two whole years has been its outer skin. One more tug and the creature is out and without the slightest hesitation it commences to crawl slowly and deliberately upward.

As it reaches some convenient spot, the cicada stops as if to get its bearings and, for the first time, it seems to realize that the soggy pads upon its back must be intended for some useful purpose. Raising them slowly the insect waves them back and forth. They bear but little resemblance to wings and yet, as they are fanned by the air and are dried by the sun, they spread and grow before our eyes, they assume a definite shape, and within a few moments they are transformed into delicate, lace-like organs of flight, although the transition has been so gradual that it is difficult to say just when the change took place, (Fig. 21E).

Now that the cicada has discovered that it possesses wings, it occurs to its mind that flying is preferable to walking, and, quick as a flash, the gauzy wings vibrate, and with as much confidence and skill as if it had flown all its life, the little creature flips up and with a happy, cheerful buzz vanishes among the leaves. There for the few short weeks of its life the cicada will remain, singing its stridulous song and sucking the sap of the trees in the summer sunshine.

Perhaps you may wonder how it happens that the cicadas' songs are heard every summer if the larva requires two years to reach its full growth under ground. The answer is that there are, and always have been, two alternating broods of these insects, so that like the poor, the cicadas are always with us. But the underground life of our common cicada is very short by comparison with that of his smaller, reddish cousins, the Seventeen year locusts

whose grubs must remain buried beneath the earth for seventeen long years. Yet in some localities the seventeen-year cicadas appear every year or every two or three years, and their appearance in less than the allotted seventeen years often causes ignorant persons to surmise that a dire calamity is about to occur. But the paradox of the seventeen-year cicadas appearing ahead of schedule is merely the result of there being two or more broods, and in reality each individual of the species has spent its full term of years beneath the surface of the earth.

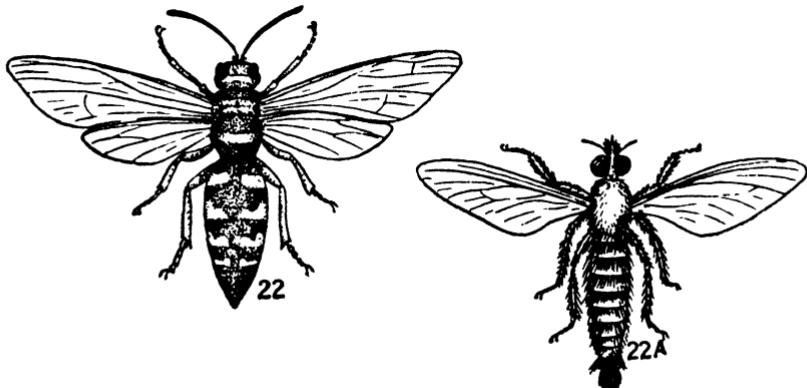
Some scientists have declared that the cicada is the most remarkable insect in all the world, and perhaps it is. At all events, it would be hard to name an insect with more remarkable habits than those of these periodical or seventeen year "locusts" as they are commonly called. Is there anything more remarkable than the fact that a clumsy grub, which for seventeen years has dwelt nearly two feet under the surface of the earth, should know exactly when its allotted imprisonment is at an end, and calculating precisely how much time will be required to dig his way to the surface, appears on the very day of the month when it is due? For hundreds of years, ever since they were first noticed and reported by the Puritans of New England in 1633, the broods of these insects have been appearing exactly on schedule. No two broods ever mix or mingle, not an individual ever has been seen ahead of time, but despite thirty day and thirty-one day months and leap years, up from their subterranean homes the cicada larvae come swarming by millions on the Twenty-fifth day of May. What strange mathematical brains must they possess; with what mechanism has Nature provided them which enables them to keep count of time for seventeen years?

No one knows, but throughout the area where a brood exists every member of the brood receives the mysterious warning that it is time to reappear. Those deep in the earth about New York know when the day arrives, so do those buried under the soil of Virginia, of Georgia, in distant Michigan, in Massachusetts and by the banks of the Wabash. It is a mystery no scientist can explain, although for many years entomologists have studied the cicadas, and every brood that has appeared has been numbered and recorded and card indexed. In all, about thirty distinct broods are known, but the best known and most carefully studied and observed of all is that known as "Brood X" which has a clear and complete record dating from 1715. It is also the largest of the many broods and covers the widest territory consisting of nearly one half of the entire country east of the Mississippi River, and everywhere throughout this immense area the members of Brood X appear at the same moment on the same day of the same month of the same year.

Almost as remarkable and mysterious as these insects' periodical appearances are their lives and habits during the seventeen years under ground. About all we know is that they dwell in deep burrows, solitary and alone, remaining almost motionless within their narrow cells and feeding on the sap of roots which they pierce with their sharp proboscis. For many years, too, scientists were puzzled as to how the cicada larva, burrowing upward from the bottom of its tunnel, left no excavated earth at the mouth of the burrow and left none behind it. But at last the puzzle was solved by watching captive cicada larvae in glass tubes filled with earth. Picking earth from above, the creature mixes it into a paste with liquid exuded from

its own body, and with the elbow of its front leg plasters it onto the wall and tamps it down, first with one leg and then another, pounding it with all its strength, until it forms a solid masonry wall to the tunnel and uses up the loosened earth.

It would seem that the cicada must lead a care-free, happy-go-lucky life with nothing to do but eat and sing throughout the summer days. But on the contrary the



creature's existence is ever one of menacing death, for he is a tempting tidbit for many a bird. Moreover, if the mind of the cicada has room for fear, these insects must live in mortal terror of a fearful enemy, a real ogre; a great brown, black and yellow brigand, who, coming on swift and silent wings, may at any instant appear. And woe to the cicada when this deadliest enemy does discover the singer. Swooping down it will seize the cicada, and stabbing the helpless insect with a cruel, poisoned dagger, will bear it away to an underground dungeon.

This winged terror of the cicada is a huge hornet, the

giant of his tribe, known as the Sphecius or Cicada Killer, (Fig. 22). It is the largest and fiercest of all our hornets and wasps, and makes its home in a burrow two feet or more in depth in the earth. Within this underground tunnel the giant hornet lays her eggs, and to provide a supply of fresh meat for the young grubs when they hatch out, the sphecius places a living cicada within each cell containing an egg. Just as the mud-daubing wasps sting spiders to render them inert and helpless without killing them, so the cicada killer judiciously stings its prey, so that powerless even to move yet otherwise unharmed the unfortunate cicadas remain in their underground prisons until the hungry young hornets emerge from their eggs and falling upon their victims rend them with ravenous jaws and devour them alive.

Let us hope that the poor cicadas are rendered unconscious as well as inert by the cruel sting of their captor and are unaware of the terrible fate to which Nature has doomed them.

Big and powerful as is the cicada killer, with a sting that is a veritable dagger, and strong enough to fly off with a full-grown cicada, yet it, too, has an insect enemy. This is the Robber fly or Hornet fly, (Fig. 22A), an insect gangster if ever there was one, a true highwayman of the air and as bold and daring as Robin Hood himself. His prey are bees and wasps, and swooping down on swift wings he attacks his victims when in full flight, and having borne them to earth and killed them he dines upon their blood.

Bumblebees and wasps, savage yellow-jackets and other hornets have no chance when grappled by this ferocious killer who is no giant but merely a large fly, but its brain

doesn't know the meaning of fear, and without hesitation it will actually attack the huge cicada killers. To see a robber fly battling with a cicada killer is an amazing spectacle. It is like a Lilliputian midget attacking a giant, and as the fly launches itself upon its huge antagonist it appears as if he were intent on committing suicide.

Yet not infrequently the fly is the victor and as the big hornet falls to earth mortally wounded the fly with a triumphant buzz settles down to its ghoulish feast. But far more often it is the daring hare-brained robber fly who succumbs, while the victorious hornet proceeds on its way, searching for cicadas, apparently as unruffled and as unconcerned as if nothing had happened to interrupt its hunting.

CHAPTER V

BOATMEN, FISHERMEN AND PIRATES

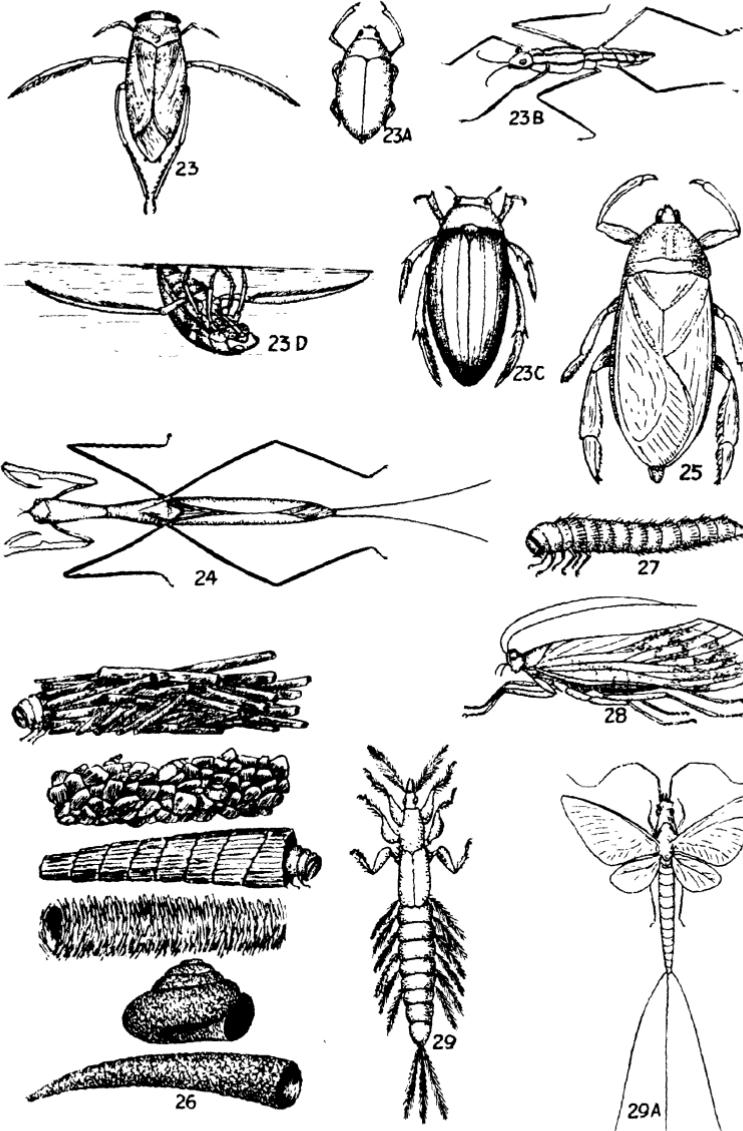
WHEREVER there is a mill pond, a lake or a stream, there you will find a world of strange insects. A world of insects whose lives in a way are much like those of human beings who "go down to the sea in ships" or wrest a livelihood from the sea, for among them there are boatmen and divers, sailors and fishermen and even savage swashbuckling pirates and blood thirsty cannibals as well as insects that make and use submarines.

Of course everyone has seen those queer insects that skitter swiftly across the surface of ponds and streams, and if you have ever tried to catch one of the creatures in order to examine it more closely, you will know how easily they evaded you. Darting hither and thither with motions so swift that the human eye can scarcely follow them, dodging this way and that, yet rarely moving more than a few inches at a time, the nimble creatures seem thoroughly to enjoy the game of catch me if you can. With their slender pointed bodies and their long legs they look so much like miniature boats with oars that they are most appropriately known as Water Boatmen. But they have one great advantage over human boatmen, for if pressed too closely or if they cannot escape by darting across the water, they can spread wings and take flight. If you should capture one of these chaps, you might find it a rather pretty insect mottled with black and pale gray and with

one pair of legs much longer and broader than the others and fringed with stiff hairs to serve as oars. The slender rear legs are used as a rudder, (Fig. 23). But the very next specimen you secure may be very different, for there are many species of these insects which row, skate or skitter over the water. Some have short oval bodies, and move so erratically and whirl about so seemingly helplessly that they resemble landsmen trying to row a stubby heavy skiff for the first time. These are the Water Whirligig beetles, and are well named, (Fig. 23A, Plate II).

Others have slender bodies scarcely thicker than their long legs and as they appear to run or walk over the water, they are known as Water Striders or Water Skaters, (Fig. 23B). Some of the water insects have two of their legs lengthened and fringed with hairs to serve as paddles, while others have all six legs paddle-shaped. Many belong to the order of true bugs with soft flexible bodies and with sharp tubular beaks for piercing the bodies of other insects and sucking their blood, but there are also true beetles with hard shining shells and with jaws designed for biting and chewing, (Fig. 23C). Many remain most of the time upon the surface of the water, while others dive readily and spend much of their lives beneath the surface.

No doubt you may wonder how insects which breathe air can live under water, and how these queer little creatures can stand or run upon the surface without sinking. But good old Mother Nature has seen to this and has provided the water insects with stiff waterproof hairs upon their bodies and legs or has given them especially designed breathing apparatus. Some come to the surface and draw in enough air to last for some time under water, but others



23 Water Boatman 23A Whirligig beetle 23B Water Strider
 23C Water beetle 23D Back Swimmer 24 Water scorpion
 25 Giant Water Bug 26 Caddis worm houses 27 Caddis worm
 28 May fly larva 29 adult Caddis fly 29A adult May fly

breathe the air which adheres to the hairs in the form of tiny bubbles. When the supply is exhausted, up the diver bobs and secures a fresh collection of bubbles at the surface. In much the same way the boatmen and others are able to rest or move upon the surface of the water, for their legs and bodies are tipped or edged with waterproof hairs and hold bubbles of air which serve as floats or pontoons to support the insects. The striders, however, employ a different principle. Perhaps you have tried placing a needle gently upon the surface of water in a dish, and have seen it float, its weight supported by the thin filament of air adhering to it. This is exactly how the striders manage, their long slender legs acting like six needles, each with its filament of air.

But the most remarkable and most interesting of all these insect boatmen is the little fellow known as the Back Swimmer, (Fig. 23D). If you should notice him swimming about upside down, you might think he had capsized and couldn't right himself. But for some strange reason, the secret of which is known only to Nature, these insects are made to swim bottom up. Very often they may be seen floating just below the surface, hanging motionless with the head down and with their shorter legs apparently clinging to the surface as if it were a ceiling and with their two long oar-like legs extended as if ready and waiting for the signal to go. And they can go! No expert oarsman in a racing shell could get under way so quickly or move so rapidly as these fellows.

If you examine one of these insects carefully, which can best be done by watching captives in an aquarium or a water filled jar, you will be mightily interested in discovering how the back swimmer manages to hang suspended

at the surface of the water and how he swims and dives and submerges for long periods. You will notice among other details that he never remains motionless for an instant when under water. He must keep on the move and upside down for he carries the lightest of all cargoes—a cargo of air—stowed beneath his wings and looking like a silver shirt, and if he should stop swimming he'd instantly capsize right side up and fall upwards. In fact he'd be in much the same fix as a real submarine should the vessel's ballast shift except for the fact that his bottom is really his top and that instead of sinking to the bottom of the water he'd rise to the top if his cargo of air did not escape before he reached the surface.

Of all the species of these funny water boatmen, the back swimmers are the most boat-like in form, the body being exactly like a decked-over hull with the insect's back serving as the bottom. To add to his topsy-turviness, the funny fellow's back is white or pale gray and his belly is dark, while his brilliant eyes shine like a vessel's running lights. If Nature had gone a step farther and had given the creature one red eye and one green eye placed on his port and starboard sides, the resemblance would have been complete, but perhaps the insect navigators do not follow maritime rules of the road or bother about lights on other craft, for the back swimmer's shining eyes are both bright red. But do not think he must spend all his time in the water. Whenever he chooses, he can turn rightside up, spread his wings and fly away. In fact nearly all of these insect boatmen can leave the water and fly, so if you do keep them in an aquarium be sure and keep it covered with netting or cloth or you'll lose your captives.

But first you must catch them, and the best way to do

this is to fish up a quantity of water weeds and plants from the bottom of a pond, for you are almost certain to find quite a number of the boatmen, swimmers and divers in this. But be careful not to place an insect pirate in the aquarium or jar with your other captives, for there *are* insect pirates who will chase and attack the little boatmen and back swimmers and scuttle and destroy them as mercilessly and completely as any of the buccaneers with a Spanish galleon. These insect pirates are the true water bugs, and look as piratical as they are in reality, with sharp, pointed, oval bodies of dull olive-green, bold staring eyes, strong powerful legs and curved sword-like front feet, while folded under their throats they carry needle pointed beaks with which to pierce the bodies of their victims and suck their blood. Some of these are small, scarcely as large as the little back swimmers, while others grow to a length of several inches. Among them are slender bodied, queer looking creatures, so much like a bit of dead stick in appearance that they may readily be mistaken for a sodden twig when they rest motionless among the trash at the bottom of the water. These are the real Water Scorpions or Water mantis, and harmless as they appear, they are most ferocious little chaps and do not hesitate to attack creatures far larger than themselves. But they are also interesting, and if you examine one carefully, you will discover how really marvelously Nature has adapted them to a piratical career while retaining their stick-like appearance, (Fig. 24). The two front legs have been transformed to powerful weapons, curved and sharply pointed like a pair of ice tongs, and with the inner side provided with a groove into which the first joint shuts like the blade of a pocket knife in its handle. Even more

remarkable is the creature's breathing device consisting of two long bristles at the tip of the abdomen. Each of these is grooved on the inner side, and when placed close together they form a perfect tube. When the water scorpion is moving about these bristles serve as rudders, and when he requires a supply of air he climbs up some weed, or other object, turns up his tail, places the bristles together, and projecting the tube thus formed above the surface he draws in what air he requires without exposing his body to hungry birds or other enemies overhead.

Very often the name water scorpion is also applied to other water bugs such as the large or Giant Water bug, the largest of all these savage insect pirates, (Fig. 25). This is a common species and preys upon frogs, newts and good sized fish, and can even inflict a painful and serious wound in a human being.

In the good old days when real pirates roamed the seas, peaceful sailing ships were helpless victims of the sea rovers. But had the Spaniards and others possessed submarines they could have snapped their fingers at the buccaneers. And down at the bottom of the ponds and streams there are insects that build submarines and have little to fear from the insect pirates and other enemies. Perhaps you may think that I am joking when I speak of insects having submarines. But you have only to search among the rocks and sand at the bottom of a stream or pond in order to find them. Place your face close to the surface and look closely at the bottom, and the chances are that you will see a number of small bundles of sticks and little cylinders of tiny stones moving about as if endowed with life. If you take them out, however, they will appear dead

and devoid of motive power, (Fig. 26). But if you break them open, you will find that each is a little tube lined with soft and shining silk, and containing a whitish caterpillar-like larva, (Fig. 27). This is the solution of the puzzle, for when the grub within his submarine dwelling wishes to move about, he pushes his head and front feet from the tube and crawls around, dragging his house behind him. But the instant he is frightened or disturbed he draws back into his safe retreat wherein he remains hidden and motionless as long as danger threatens. Moreover, he can navigate his submarine almost as skillfully as any underseas sailor. Within it he can rise to the surface, move about on water plants or over rocks, he can dive to the bottom or can defy the swift currents of rushing streams. His own muscles are his motive power. Nature has endowed him with the ability to extract oxygen from the water, and as he increases in size he can build his submarine larger and larger by spinning more silk and adding more sticks or pebbles to the outside of its walls.

You will find there are many sizes and many different forms of these funny fellows and their homes. Some of the tubes are cylindrical and are made of sticks placed lengthwise while others are constructed like little log cabins with bits of straw or chips placed criss-cross. Very often you will find them decorated with tiny snail shells attached to the walls to serve as camouflage, and not infrequently living snails are securely fastened to the tubes and are thus compelled to move about at the will of their landlord. Others are made entirely of moss or of leaves while the most numerous of all are those built of grains of sand or tiny pebbles. These are usually smooth and regular cyl-

inders, but by far the most beautiful and most cleverly made are those shaped like spiral shells or in the form of curved cones like miniature tusks, (Fig. 26).

The little creatures which build these mobile submarine homes are the larvae of winged insects known as Caddis flies. Hence they are called Caddis worms, and not only are they submarine builders but many species are also expert fishermen as well. Between the stones where some brook flows swiftly you may find their silken nets. These are funnel shaped with the larger opening pointed upstream, while across the inside there are fine threads crossing one another at right angles, the whole forming a fish trap as ingenious and as effective as any constructed by human fishermen.

Although these funnel shaped nets are the commonest form, other species of caddis worms make nets of a different type which may be found on the edges of waterfalls. These consist of little semi-oval silken cups attached to the sides and surfaces of the rocks and kept open by the force of the current. Not only do these capture all sorts of tiny insects and other creatures on which the caddis worms feed, but they also catch great quantities of dirt scum and other rubbish, and it is this flotsam firmly held in the silken nets that gives the rocks and stones their coating of dirt in summer time.

When the caddis worm has grown to full size he draws himself within his submarine and builds a silken door across the entrance, always leaving a tiny opening so that water may pass in and supply him with fresh oxygen. Having thus locked and barred his door, and quite safe from harm, the insect fisherman changes to a pupa. In due time the pupa bursts open, the silken door is torn

down, and a strange looking insect comes forth. Using its long middle legs like oars, the newly emerged creature swims rapidly to the surface of the water, finds a rock or stick and crawls out. Almost as soon as it reaches the open air a pair of tiny pads upon the insect's back expand, and as if by magic, are transformed into four delicate hairy brown wings with which the owner flies away, showing no slightest difficulty in using this new form of locomotion, (Fig. 28). Here again Mother Nature has provided most wisely for the caddis fly's needs, for if the insect's wings required as much time to expand and dry as do those of most insects, the caddis fly would almost certainly be swept away by the current before it could seek safety in flight, or would be gobbled up by some hungry dragon fly or frog while still clinging helplessly to its support beside the water whence it had emerged.

The life of the adult caddis fly is brief and measured by days, but there is another denizen of ponds and streams whose adult life is measured by hours. Among the muck and trash beneath the water, crawling about with the larvae of dragon flies, water boatmen and caddis worms are many lively little creatures with fringed gills along their sides and with several feathery appendages projecting from their tails. They have strong legs and can both swim and walk rapidly, (Fig. 29). The principal business in life of this creature seems to be to molt, for it changes its skin often, usually about twenty times, and after it has shed its skin the ninth time four little pads appear upon its back. With each successive molt these pads grow larger, until at the end of two or three years the larva again sheds its skin, and it crawls from the water a winged insect, but mouthless, the mouth parts having

gradually disappeared as the wings developed. But the loss of its mouth does not trouble the odd insect, for during the remainder of its life it will not require food. Many other changes have taken place, also. No longer is the little pond dweller a sturdy dull-brown insect with a tough thick skin and strong legs. Its body is now almost transparent, its slender legs seem scarcely able to support its weight, so light and frail looking has it become, and its slender tail bears three long, thread appendages. In fact, it has been transformed to the insect known as the May fly, (Fig. 29A), and spreading its delicate lace-like wings it flutters feebly from its perch. But old habits seem to be very strongly fixed and breaking all established rules of the insect world, the little creature once more sheds its skin, thus rendering itself unique among insects, for the May flies are the only insects to shed their skin after reaching the winged state. With this final molt the May fly appears almost wraith-like, and were it not for the fact that its internal organs and its pulsating blood are visible within its transparent body it might well be taken for an insect ghost, and we marvel that a creature so frail can possess the power of flight, or a body so ephemeral can support life. And we marvel still more and watch enthralled when on a spring evening we see the May flies dancing in air above some grassy meadow beside a brook or pond. No doubt it was these strange pale insects dancing in the moonlight that gave rise to the tales of fairy dances, for no lovely fairies in gowns of spiders' silk move with more rhythmic grace or greater abandon. But for the May flies it is a dance of death. Before the night is ended and the sun shines once again the life of the little creatures will be over, for the insects which have lived for

years as grubs beneath the water enjoy but a few brief hours of life in the adult state.

But before her short life is over the female May fly has one last duty to perform. Wrapping her wings about her body, she transforms herself to a living diving bell, and plunging beneath the surface of the nearest pond or stream she lays her eggs beneath some stone or sunken log and dies. But many never have time for this and merely drop their eggs upon the water before expiring. And there are countless thousands whose lives are ended even sooner than Nature intended, for there are few insects which are so fascinated by lights, and oftentimes they gather by thousands about some electric street lamp, filling the air like a misty cloud, darkening the globe of the light with their crawling forms, and falling to earth, maimed or dead, until the sidewalks are slippery with their crushed bodies and crumpled wings. It is a wholesale sacrifice to the God of Light, but Nature is prodigal, and for every May fly thus destroyed a score of others hatch from the eggs beneath the stones at the bottoms of the ponds. Neither is it a wholly wasteful sacrifice, for the flitting bats find the swarming May flies exactly to their liking, and multitudes of those which fall to the earth are gobbled up by hungry waiting toads, while countless millions of May flies which fall into the water are snapped up by hungry fish. In fact, in many localities they are known as "shad flies", and every rod and fly fisherman knows how tempting an artificial May fly proves to many a wary trout or bass. As the fairy-like insects are neither friends nor foes of man, probably the most worthy purpose they serve is to provide abundant food for our valuable fishes and for bats and toads who are our firm and useful friends.

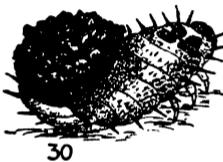
CHAPTER VI

INSECT GEMS

PERHAPS you may have noticed in some jeweler's window odd pieces of jewelry set with objects of gleaming bronze green which look like dainty scarabs carved from iridescent metal. They are not, however, the work of clever artizans but are the hard, dried shells of insects known as Brazilian beetles. They are really lovely things, as beautiful as any gems, and we think how wonderful it must be to see such insects crawling about in their living state. But we need not travel to South America to find shimmering jewel-like insects. Many of our beetles are just as lovely, and many are far lovelier, than the beetles from Brazil, although none of our northern insect gems have shells thick and hard enough to be mounted in jewelry. Several of our most beautiful metallic-hued beetles are near relatives of the Brazilian beetles most commonly seen, and belong to the group known as Tortoise beetles. They are well named, for they are much like miniature tortoises in form and move about with a slow and deliberate motion which is very turtle-like, (Fig. 13, Frontispiece). To be sure they are much smaller than their tropical cousins, but they are even more brilliant and metallic-like in color. Many species gleam like burnished gold, copper or silver, others are steel-blue, amethyst or emerald-green, while still others combine several hues, but nearly all glow with a metallic luster. They are such jewel-like beautiful

creatures that it seems a great pity that they are most destructive insects, and cause a great deal of damage to many flowering and useful plants, especially the morning glories, peas and beans and sweet potato vines. In their larva stage they are even more destructive than when fully grown, but you would never guess that the queer grubs were the young of such gorgeous little creatures.

Flattened and dull-brownish or black and covered with short stiff hairs or spines, the young tortoise beetles look like lilliputian prehistoric monsters and have the strange habit of holding their tails cocked up or curled over their



backs and carrying cast-off skins and bits of excrement like a miniature parasol, (Fig. 30).

Another gem-like beetle which is even more beautiful in its lustrous metallic reflections and colors is common on the leaves of the plant called dog bane, and as they feed only on this wayside weed, they are not injurious, but are really useful insects. These plump little chaps may often be found by scores on the dog bane plants, their iridescent, prismatic colors gleaming in the sunshine so that the leaves appear as if studded with countless precious gems, (Fig. 14, Frontispiece). Although these little insect jewels are far too frail to serve as jewelry, they are sometimes used as beads by the Indians, and when threaded on a string to form a necklace, they are far more gorgeous and beautiful than any priceless diamonds, pearls

or other precious stones worn by the wives of multi-millionaires. Among the Indians of South and Central America, beetle-wing necklaces, arm bands, ear ornaments and other personal adornments are very popular, and it is not unusual to see an Indian wearing many yards of thick cylindrical strings of the gleaming green, purple and flaming golden wings. Most of these are the wing covers of big oval shaped beetles known to scients as Buprestids. In general appearance these insects resemble the common snapping beetles or click beetles, but unlike the latter, the buprestids are almost always brightly colored and have a brilliant metallic luster. In the tropics there are species several inches in length and some of our northern species are over two inches long, (Fig. 15, Frontispiece). The larvae of these lovely beetles bore in trees and sometimes cause a great deal of damage while some species of the beetles when eaten by grazing cattle are very deadly poison. In fact the name of this family of beetles was given them because of this, the word *Buprestis* being derived from *bous* meaning an ox or cow and *prethein* meaning to blow up, for cattle which accidentally swallow these insects swell up and die.

Still another of our insect gems, and the largest of all found here in the north, is the big Carib beetle or Searcher beetle. Savage and ferocious enemies of all caterpillars and other insects upon which they feed these largest of our ground beetles are well named Carib, for the word is merely a corruption of cannibal and was bestowed by the Spaniards upon the warlike and man-eating Indians who inhabited many of the West Indian islands as well as the northern portions of South America. Searcher beetle, however, is just as appropriate, for the big active beetles

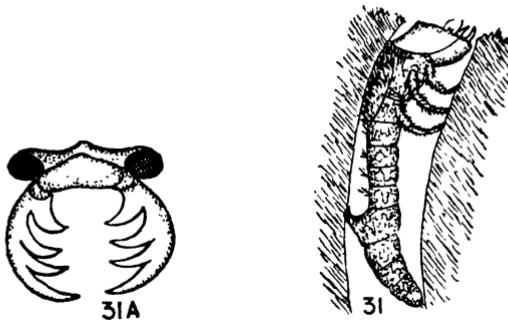
are forever hunting for victims, running swiftly about, searching in the weeds and grass, under stones and beneath the bark of trees for grubs, caterpillars or other insects to fill their ever hungry stomachs. There is something indescribably bold, savage and bandit-like about their appearance and they are as bold as they look, making no attempt to conceal themselves but flaunting their brilliant colors in full view. They have little cause for fear, however, for they are swift of foot, they can fly readily, they have powerful jaws with which to defend themselves, and they emit a most nauseating and disagreeable odor which protects them from birds and other enemies. Some species are black or dull colored studded with gem-like spots of flashing red, gold or green, while one of the commonest is metallic brilliant green on the back with the head and thorax and the edges of the wing covers iridescent purple and gold, (Fig. 16, Frontispiece). They are as useful as they are beautiful and are true insect friends of man, for they kill and devour countless harmful insects, especially the injurious canker worms that play havoc with our shade trees and cultivated plants. Still another of our insect friends is an insect gem as handsome and as savage a raider as the Carib beetle. These are most fittingly called Tiger beetles, for no great striped cat of the Bengal jungles is more ferocious in its habits than these swift and agile insects. Their long, slender but strong legs enable them to run with amazing speed, and like their furred namesakes they can leap for a surprising distance to pounce upon their prey. And they are as swift of wing as they are fleet of foot. Their large heads and big bright eyes give them a most alert and intelligent appearance, while their curved sharp jaws are as deadly weapons as a real tiger's

teeth. Woe to the insect that the tiger beetle sees as he flashes through the air on his swift wings or dashes hither and thither over the ground, stopping now and again to raise his head and peer about with the sunlight gleaming from his burnished coat of mail. Anywhere along the borders of dusty roadsides, in woodland paths or in sunny fields you may meet him, and though he may be any one of a number of species you cannot fail to recognize him by his quick motions, his queer habit of teetering as he stands or runs and his brilliant metallic jewel-like colors, (Fig. 17, Frontispiece). Many are golden or emerald green, others purple or blue, copper colored or golden, and most of the species have the metallic surface of their wing covers marked with contrasting lustrous colors giving the effect of being studded with rubies, emeralds, sapphires or diamonds.

If you are observant you may notice that the tiger beetles are seldom seen except on bright sunny days. The reason is that when it is dull or rainy these insects hide away in burrows in the earth and come forth to hunt their prey only when the sun shines brightly.

Even in their larva state the tiger beetles deserve the name they bear, for though mere grubs, slow of motion and wingless, the young tiger beetle is as bloodthirsty and fierce as its parents. It is a clever creature also, for being unable to chase and capture its prey, it turns trapper. Burrowing in the earth, the tiger beetle grub lies motionless just within its hole with its big, dark-colored head bent downward and blocking the entrance and thus appearing like a bit of inanimate stone. Patiently it waits until some hurrying, unwary insect steps upon the living trap-door

when instantly the grub drops to the bottom of its hole where its victim falls into the hungry jaws of the savage trapper, (Fig. 31A). Sometimes it happens that the creature trapped is larger and stronger than the trapper, and in the struggle the tiger beetle grub might be dragged from its hole and the tables turned, were it not for little humps upon its back which enable it to hold onto the interior of its burrow like grim death, (Fig. 31). All men trappers know how necessary it is to remove all traces of the trapped animals from the vicinity of their traps if they



expect to catch more of the same creatures. The little grub trapper is just as wise, and he most carefully clears up after his meal and removes all remnants of his prey from the vicinity of his burrow.

Interesting and strange as are the lives and the habits of the tiger beetles' larvae, they have a first cousin that has an even stranger manner of life. The larva of this ground beetle lives on the sea shore and feeds upon sea shells. It is a marvelous sight to see one of these grubs attack a snail. Tapping upon the shell he listens and in this way learns if

the shell is occupied. If empty he hurries off to find another, but if the shell is alive he turns to the opening, tears at the horny door and tough muscles until he forces his way in, and having devoured the occupant of the shell calmly takes possession and dwells within it.

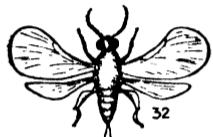
CHAPTER VII

THE INSECT MAGICIAN WHO GIVES US FIGS

I WONDER how many persons who eat Smyrna figs realize that the luscious fruits are the work of a tiny insect, a true insect magician, who by its magic transforms small and worthless flower buds to the big, plump, sweet and toothsome figs we know and love so well. Yet were it not for a little wasp no larger than a small mosquito or a gnat there would be no delicious sugary figs in all the world.

From the earliest days, long before written or recorded history began, the people of the East and of southern Europe have cultivated the fig, and of all the many varieties of this fruit the figs of Smyrna became recognized as the finest in the world. But there were no native figs in America, and it was not until the eighteen eighties that the Smyrna figs were introduced to California when a San Francisco newspaper imported 14000 Smyrna fig cuttings and distributed these among the paper's readers. The cuttings grew readily and California fruit growers had rosy dreams of establishing a new and most lucrative industry. But when four years had passed and the fig trees should have been loaded with plump and luscious fruit, bitter disappointment filled the hearts of their owners. Not a single fig was to be found upon any one of the thousands of trees. Everywhere were tiny wizened buds which dried up and dropped from the branches without maturing, for it must be remembered that the fig is not a true fruit, but a

flower turned inside out with its petals and pistils inside a hollow fleshy bowl. Something was wrong, but no one could offer an explanation, and at last the United States Department of Agriculture was appealed to. But at that time the reason for the failure of the fig crop was as much a mystery to the scientific experts as to the California fruit growers. The government did not let the matter drop there, however. If Smyrna fig trees produced fine figs in Smyrna then there must be some good reason why Smyrna fig trees did not produce edible fruit in California, and the scientists intended to leave no stone unturned until they



discovered just what that reason was. So an expert was despatched on the long journey to Smyrna to investigate.

He had not been there long before he noticed a curious ceremony being carried out by the natives. Growing wild were countless fig trees whose fruit, known as caprifigs, were small, hard and worthless and were never eaten. But the natives carefully gathered these, and looping them on strings hung them in their fig orchards, explaining to the American that by so doing they kept evil spirits from visiting the orchards and destroying the crop of Smyrna figs. Of course the matter-of-fact scientist had no faith in evil spirits or any such nonsense, but he realized that the superstitious natives were much in earnest, they all insisted that unless the caprifig "charms" were placed in the orchards, there would be no crop, and deciding there must

be some connection between the wild figs and the crop of Smyrna figs, he carried on a searching and minute investigation. Then one day he noticed a number of small fly-like insects emerging from the suspended caprifigs, (Fig. 32). For a space the tiny insects crawled about as if hunting for something, and then, taking wing they flew unhesitatingly to the nearest immature Smyrna figs upon the neighboring trees. Excitedly the elated scientist watched them, for he realized he was on the verge of a great discovery, that the mystery of the figs was nearing solution, and he could not afford to miss the most trivial detail of the magic being performed before his eyes.

Alighting at the "eye" of the immature figs, the little wasps commenced burrowing their way into the fruit-like flowers, working so furiously and forcing their way inward through such a narrow opening that many actually tore the wings from their bodies. But despite their evident madness to enter the fruit they quickly reappeared, and crawling from the aperture they had made, fell helpless and wingless to the earth where they quickly died.

Already the expert had guessed what had taken place. The little Fig wasps emerging from their pupae within the caprifigs had carried the pollen from these to within the Smyrna figs and had fertilized the latter so they would mature and produce seeds and the rich sugary pulp surrounding them. But he was still greatly puzzled. If the little wasps had entered the figs for the purpose of making nests for their offspring, and had laid their eggs within, why were the fully developed figs free from the grubs or larvae of the wasps?

Patiently he watched, waited, observed, studied and experimented until at last he had unravelled the whole

mystery. He discovered that the young wasps could not live within the Smyrna figs. Only in the wild caprifigs could they breed and survive, and the winged insects which had gnawed their way so furiously into the immature flowers on the orchard trees had been driven by mad instinct and had entered the Smyrna figs by mistake. Here indeed was a strange and amazing thing; the error of a tiny insect benefiting man and dooming itself to an untimely death. Instead of driving "evil spirits" from their orchards the natives were releasing good spirits by their "charms".

But the scientist was far more interested in the problem of introducing the insect magician to California than in the wonders of the discovery he had made. Neither was his a simple problem. Within the wild caprifigs the little wasps passed through their life cycle in two weeks. Without new and fresh caprifigs in which to lay their eggs the insects could not survive, and there was no means of getting the infested caprifigs to California in two weeks. For four long years the government wrestled with the problem. But where there is a will there is a way, as the old proverb tells us, and at last success came. Collecting infested caprifigs in northern Africa, the nearest point to the United States where they were available, a government agent wrapped each of the fruits in tinfoil to preserve their moisture and rushed them by the fastest routes to California. They arrived in time but not a day too soon. Almost immediately the little wasps emerged; to the delight of the anxious experimenters the insects showed no signs of feeling strange in their new land but immediately commenced to breed in the growing caprifigs which had been provided for them, and in four weeks thousands of

fig wasps emerged. Rapidly they increased. The thousands grew to millions. Everywhere where there were fig trees in California the winged magicians were introduced, and as if by magic the trees began to bear abundant crops of luscious, sugary figs as perfect and as fine flavored as those of far-famed Smyrna.

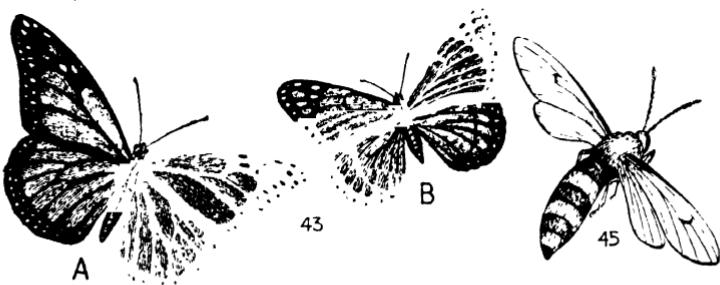
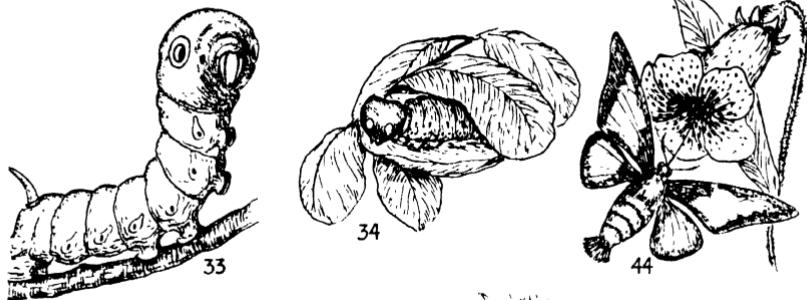
As long as there are caprifigs there will be fig wasps and as long as there are fig wasps the little insects will continue to make mistakes and push their way blindly into the sealed flowers of the Smyrna fig trees. Yet if for any reason, if through some wide spread blight, the appearance of some new and destructive enemy or disease, the wild caprifigs should be utterly destroyed for only two weeks' time, not another smyrna fig would be produced in the entire world.

Truly, in all the pages of history and of adventure, either of fiction or of fact, there is no stranger, more romantic story than that of the little insect which by the magic of its mistake gives Smyrna figs to man, and by its blunder loses its own life and forfeits parenthood.

CHAPTER VIII

INSECT BUGABOOS

IF you were a hungry bird seeking for juicy caterpillars among the leaves of a grapevine, and you should come suddenly face to face with a menacing snake-like head waving slowly back and forth and staring at you with great goggly eyes, what would you do? Of course you would be scared and without waiting to investigate you would fly away as fast as you could. And that is exactly what many a hungry bird does when it suddenly confronts the big Sphinx moth caterpillar, (Fig. 33, Plate III.) And how plump Mr. Caterpillar must chuckle to himself at having frightened off his enemy, for he is perfectly harmless and merely an insect bugaboo. Nevertheless, he is such a dangerous looking creature with the swollen fore part of his body, a horn on his tail, and big eyes looking quite ferocious, that few human beings dare to touch him. But the "stinger" on his rear end is almost as soft as the rest of his body and incapable of even scratching one's skin. He is in fact, an excellent example of bluff, and he and his ancestors from time immemorial must have found bluffing saved their lives on many occasions, for a number of sphinx moth caterpillars have the artificial eyes and a horn, while those which lack the latter have another artificial eye in its place, thus being able to outstare an enemy regardless of which end is threatened.



33 *Sphinx larva* bugaboo 34 the locust Jack-in-the-box 35 PLATE III
 he mimic cobra 36 the Owl butterfly 37 the Monarch (A)
 and his Viceroy (B) 43 Humming Bird Hawk moth 45
 Tornet moth

The sphinx larvae are not unique in their game of pretending they are dangerous serpents. Many of the caterpillars of moths and butterflies wear eye-like color spots, and if you search carefully among the leaves of sassafras, you will probably discover a large leaf that is neatly rolled with its edge fastened down with little silken threads, or you may find two leaves fastened together to form a little tube. At first sight it seems empty but touch it gently or thrust a blade of grass or small stick within and the chances are you will draw hastily back in amazement and surprise, as out from the leafy tube pops a fearsome looking head, the head of some strange creature which might well be some deadly serpent coiled within the shelter of the leaves, a head emerald-green above and pink below, bearing two great baleful yellow rimmed eyes, and seemingly with open mouth showing menacing sharp fangs, (Fig. 22, Frontispiece). Moreover, if greatly disturbed or irritated it will project a forked orange "tongue" or "horns" from the forward part of its body. This not only adds to the snake like effect, the organ appearing much like a serpent's forked tongue, but in addition these "horns" emit a most disagreeable and nauseating odor. Altogether it is quite terrifying enough to frighten any self-respecting bird half out of its wits, but it is really a perfectly harmless creature, the larva of the big black and blue Swallow-tail butterfly known as the Troilus, and when seen outside its leaf shelter it is not at all frightful in appearance, (Fig. 22A, Frontispiece).

An even stranger bugaboo dwells in a little tent made of locust tree leaves drawn together by silk threads. He is a real jack-in-the-box, and when he pops out with his big, triangular, brown head wiggling loosely on the slender

neck that connects it to his tapering green body, and stares at you solemnly with his round, orange, artificial eyes (Fig. 34), you will surely burst into merry laughter. He may think himself a terrifying looking creature, a real bugaboo, but he is merely a clown, and having waggled his head, which seems hung on spiral wires like that of some toy, he appears suddenly to realize that you are not frightened and hastily retreats to his wigwam. But two seconds later he will pop out once more if disturbed and will repeat the performance again and again until too weary even to waggle his head. This funny little fellow is the caterpillar of the silver spotted Skipper butterfly, and having grown to full size he wraps himself in a silken blanket within his tent, and transforms to a chrysalis.

No doubt these caterpillar bugaboos frighten away many a bird and other enemy, but they don't fool the ichneumon flies, those wasp-like, relentless foes of all caterpillars which I have already described. Perhaps the ichneumons have keener eyesight than the birds and recognize the caterpillars for what they are, or possibly they lack imagination and see nothing terrifying about fake eyes and horns. At any rate the ichneumons are not frightened away, and the sphinx larvae with their staring artificial eyes and menacing attitudes are the commonest victims of these parasitic insects.

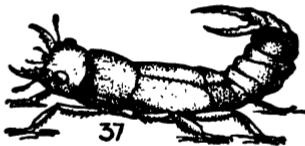
Although most of our insect bugaboos are caterpillars, there is a moth which outdoes them all. This is the big Atlas moth of the East Indies, the giant of the moth family, and a very handsome insect when seen with its great wings expanded. But when at rest a wonderful transformation takes place, for the Atlas moth seems to possess real intelligence, and clinging to some object holds

its body and folds its wings in such a way that they appear so much like the head of a deadly cobra that even human eyes are often deceived, (Fig. 35). There is the vicious looking snake's head with its cold, baleful reptilian eye above the closed mouth and back of it the broad flattened hood with the spectacle-shaped marking of the most dreaded and deadly of snakes. Yet all a counterfeit, a mere effect produced by the form and markings and the attitude of the moth's wings.

On the other side of the world, in the tropical forests of South and Central America, another big insect goes the Atlas moth one better. In this case it is a butterfly. A great handsome broad winged creature that flits through the jungles, vanishing in the shadows one moment, gleaming like burnished blue steel in some patch of sunlight the next instant. Presently it settles down and alights upon a dead branch. Anxious for a closer view you approach cautiously and gaze puzzled. No butterfly is visible, but perched upon the limb and regarding you with wise round eyes is a little gray owl, (Fig. 36). Ah ha! his presence solves the puzzle, you think. Of course he has gobbled up the butterfly. But take a step nearer and see what happens. The little owl takes fright and flits from its perch, and before your wondering eyes is transformed to a butterfly as if by some amazing feat of magic. But there is nothing magical about it, it is only an optical illusion, the position of the butterfly's folded wings and the mottled gray and brown of their under surfaces with the eye-like spots the exact counterfeit of an owl when the insect is at rest. But the Owl's Head butterfly as it is called is nobody's fool. He seems to know that a human being cannot be so readily hoodwinked as a bird, and perhaps he realizes that a man

cannot capture him when on the wing, and so, instead of trusting to his masquerade when a big two-legged enemy approaches he takes to flight. But let a bird come near and he will remain motionless, simulating an owl and trusting entirely upon his bluff for his safety.

Imitating snakes or owls or weird terrifying creatures is not the only bluff of the insect bugaboos, however. Comparatively few persons will dare to pick up an Earwig, yet the earwig is a most harmless and defenceless insect. But the useless pincers at the tip of its tail *look* dangerous, and it twists its abdomen upward and moves it menacingly like a scorpion about to strike, (Fig. 37), and even if he

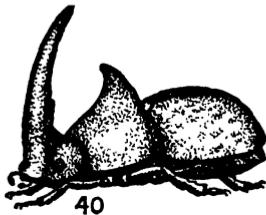
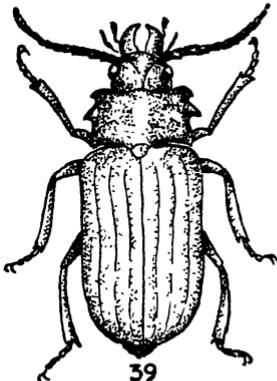
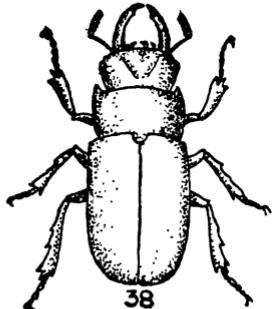


is only a terrorist, an out and out bluffer who at heart is a timid little rascal, the bluff works. Millions of earwigs for millions of years have saved their lives by scaring off enemies in this way, with the result that all of their kind have inherited the habit.

Among the members of the beetle family the game of bluff is played everywhere by countless species of this vast army of hard-shelled insects. Even the common Stag beetle, (Fig. 38), is a good deal of a bluffer for his savage looking great horny jaws are incapable of inflicting any great damage. But beware of the big, black long horned Musk or Goat beetle, (Fig. 39). He does not need to bluff for his short powerful jaws, designed for cutting through

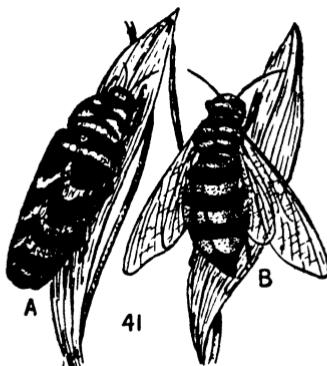
solid wood, can take a piece out of one's finger as neatly as you please.

The big, clumsy Rhinoceros beetles looking like minia-



ture editions of lumbering prehistoric monsters with their grotesque dangerous looking horns, (Fig. 40), are all bluff. They may masquerade as powerfully armed creatures capable of defending themselves with their big sharp horns, but they are merely bugaboos and don't even know how to use their counterfeit weapons when occasion arises. Other members of the beetle tribe follow a very different but just as effective a method of bluffing. Instead of wearing dummy horns or carrying useless pincers with which

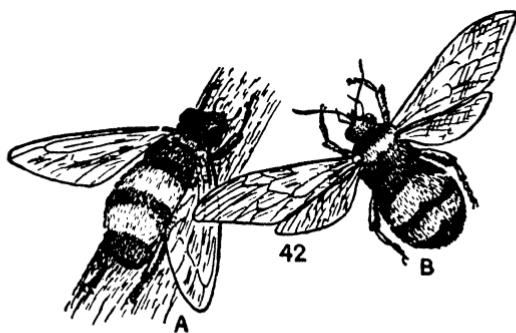
to frighten off their foes, these fellows masquerade as well known dangerous insects. If you search among the goldenrod flowers on some hot and sunny July day, you will no doubt find a number of the big black and yellow hornets known as Yellow Jackets. And of course you will be very careful not to meddle with them or interrupt them at their meals, for they are short tempered creatures and use their powerful stings on the least provocation as everyone knows. Yet if you are "in the know," you may astonish



your friends by calmly plucking one of the black and yellow insects from among the flowers and holding him in your fingers despite his angry struggles and thrusting tail, for sharing the pollen with the hornets are beetles so similar to the yellow jackets in color and markings that the average person would never note the difference, (Fig. 41).

This habit of counterfeiting some well known poisonous or dangerous species is quite a common form of bluff in the insect world. Several kinds of perfectly harmless flies imitate honey bees, while one big fly is such a perfect double for a bumblebee that it is practically impossible to

distinguish the fly from the bee without examining their wings, the fly having two wings while the bee has four, (Fig. 42). But who wants to take the risk of molesting a buzzing black and yellow insect on the chance that it may be a bluffer and not the real thing? Not only do these counterfeits look like the real bees, but they buzz in the same way and when captured they stab viciously with



their stingless abdomen as if still in hopes that their bluff might work.

Even the butterflies have adopted this custom of masquerading and go through life posing as something they are not. Nearly everyone is familiar with the common chestnut brown and black Milk Weed butterfly or Monarch (Fig. 43A, Plate III), but comparatively few know that the conspicuous monarch is a far from inviting tidbit for birds which prey upon insects owing to the fact that it has a strong and disagreeable odor and taste. In fact, it is almost immune from attack by enemies of butterflies in general, and can flaunt its brown and black wings in comparative safety with no need of concealment. But there is another butterfly who knows the monarch is avoided

by hungry birds and takes advantage of the fact, although perhaps it would be more accurate to say that Mother Nature has done so and the butterfly itself has no part in the matter. But it is sometimes a very difficult matter to say positively whether blind instinct and Nature's laws or true intelligence guide the insects, and at any rate this butterfly, which belongs to a different genus from the monarch and is considerably smaller, wears a dress so similar to that of the monarch that nine out of ten persons would never notice the difference, (Fig. 43B). In fact only by the shape of the wings and its smaller size can the masquerader be distinguished except by an entomologist, and as a result, the Viceroy as this butterfly is most appropriately called, fools many a bird and flits about in the sunshine in plain sight, despite the fact that he is a tasty morsel and were he wearing the blues and whites of other members of his genus he would instantly be gobbled up.

The viceroy, however, is not the only copy-cat among our butterflies and moths. Often during the late spring and summer you may see the Humming Bird Hawk moths hovering over the flowers in gardens or fields, although the chances are you have never guessed that they are moths but have mistaken them for real humming birds, for they are so much like the tiny feathered gems that anyone might be fooled, (Fig. 44). They are nearly the same size, they flash with lightning like speed from flower to flower in the same way, they hover on invisibly vibrating wings sipping nectar from the blossoms, and they revel in the blazing sunshine which is avoided by other moths. But if you capture one of the little creatures, you will discover that there really is little similarity between it and a hum-

ming bird, and is unmistakeably a moth with gauzy wings, a stout velvety body and six fuzzy legs. Only when in flight or dining on the honey of the flowers does it masquerade as a bird and thus safeguard its life, for if it can hoodwink human beings, it can fool its bird enemies who would never dream of molesting a humming bird.

Other moths, which in general appearance closely resemble the humming bird hawk moths but are much smaller, pose as hornets and are so much like hornets in colors and actions with their transparent wings that they are known as Hornet moths, (Fig. 45). Although in many ways so similar to the humming bird hawk moths, these insects belong to a different family. The larvae of the former are typical sphinx caterpillars, green in color with horns on their rear ends, and feed upon the foliage of wild cherry, blueberry and other plants. Unlike other sphinx larvae they do not bury themselves in the earth to pupate, but spin a thin silken cocoon among dead leaves within which they transform to a chrysalis. But the larvae of the hornet moths are borers and their life history is most interesting and remarkable.

Searching about until she finds a suitable hole or crevice in the bark of some tree, the mother hornet moth deposits her eggs and flies away. In due time the eggs hatch, and instantly each little grub commences to burrow its way into the wood until well out of sight. But the young moth does not intend to be taken unaware by some enemy attacking it from the rear, so he interrupts his boring to plug the entrance of his hole with bits of wood held together by silk. Then, feeling secure against invasion, he continues on his way until at last he reaches the very heart of the tree. Now he turns at right angles and commences eating out a

tunnel, first erecting another barrier behind him and for two years dwells within his tunnel, feeding upon the heart of the tree which shelters him, until fully grown. Then for the first time he turns around within his narrow home and faces the little door he built two years earlier. It seems as if he actually knew what would happen if he failed to turn, and realized that if he shed his skin and became a chrysalis with his tail towards the entrance to the burrow he could never turn about and leave his narrow home.* But once he has turned about while still a soft and mobile grub, all is well, and settling down he wriggles from his skin and becomes a shiny brown pupa. For a few weeks the chrysalis remains motionless within the hole, and then one day it shows signs of life. And marvel of marvels, although legless and eyeless it begins to actually climb upward along the tunnel. Reaching the barrier the strange thing tears it down, onward it wriggles towards the outer world; it bursts its way through the first frail barricade erected, and reaching the entrance to the burrow thrusts itself forward until it seems about to topple to the earth far below. But insenseate as it appears, the pupa knows when to stop and at the very brink of eternity as it were, it splits open along the back and from the aperture the full grown hornet moth comes forth, to dry its soft and crumpled wings in the sunshine and buzz off like a true hornet for its first meal of honey and nectar sipped from the nearest flowers.

Pages might be filled with stories of insect bugaboos, bluffers and masqueraders, for their numbers are legion. But perhaps the most remarkable of them all is the larva

* The larva of the Musk beetle or Goat beetle already mentioned has exactly the same remarkable habit of turning about to face the entrance to its burrow before it transforms to a pupa.

of a beetle which feeds upon ants, for having dined upon some unfortunate ant, the ferocious little larva places the head of its victim upon its own shoulders hiding its true character under the gruesome mask in order to escape detection by his prey, (Fig. 46).

There are many insects whose bluff is by no means all bluff, however, for these, finding they cannot scare an enemy away, resort to far more strenuous measures. Such are the little ground beetles known as Bombardiers. Turn over almost any old stone or fallen tree and you will find



them, harmless looking little chaps, often with black or blue backs and orange or brown heads, who scurry hither and thither searching for new hiding places but stopping now and then to raise their tiny heads menacingly or to lift their tails as if threatening to sting. Pure bluff of course, but try to capture one and see what happens. Quick as a flash the little beetle will whirl about, lift his abdomen and with a scarcely audible "pop" a little puff of bluish vapor will be discharged from the insect's tail, (Fig. 47). Of course you will chuckle with amusement and delight at this surprising cannonade, for the Lilliputian artillery of the bombardier beetle is as ineffective when fired at a human being as a toy pop-gun to an elephant. But the beetle doesn't know this. Nature has provided him with this means of defence, and he uses it whenever danger

threatens and bluff fails. And a most effective defence it is when directed against some savage tiger beetle, a ferocious Carib beetle or any other insect enemy, for the vapor discharged by the bombardier beetle is deadly poison gas, and millions of years before the outbreak of the World War, these insects were using this effective weapon of modern warfare.

Remarkable and interesting as are these little poison gas bombers they are not so strange as the larvae of a common moth. Oddly colored and marked with green, white and lilac, and with long forked tails, these caterpillars when feeding or at rest on a leaf blend beautifully with their surroundings and appear merely a bit of withered and injured leaf. But the instant they are disturbed or danger threatens they become completely transformed. Rearing up on their hind legs, they elevate their forked tail and wave it threateningly. Upon the swollen forward part of the body a hidden band of scarlet and a pair of imitation eyes appear, and instead of a harmless caterpillar there is a ferocious looking little monster menacing its foe with open mouth as if ready to attack anything, (Fig. 23, Frontispiece). So far it is all bluff, the insect trusting to its bugaboo appearance and its menacing attitude for self protection. But the Puss moth caterpillar, as it is called, has another card up its sleeve. If worst comes to worst and the enemy approaches too closely, the caterpillar jerks up its head and spits as viciously as any angry tomcat. But while the feline's spitting is harmless it is a very different matter with its insect namesake, for when the puss moth caterpillar spits, it ejects a tiny stream of irritating poisonous liquid which will blind any small bird it strikes or will bowl over an insect foe.

CHAPTER IX

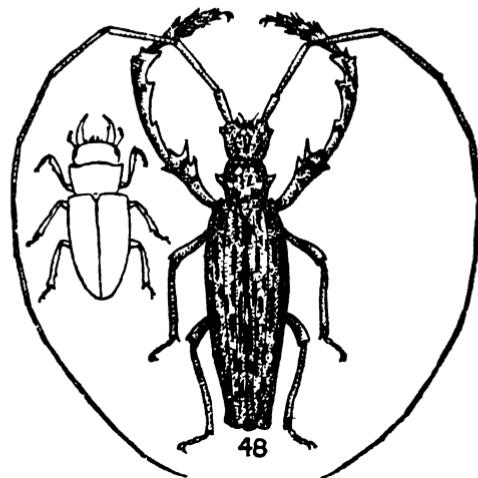
SOME GIANTS OF THE INSECT WORLD

JUST as there are midgets and giants among members of the human race, so there are giants and dwarfs in the insect world. But there the similarity ends, for while human giants and human midgets are merely abnormalities or freaks, and men and women as a whole are of nearly uniform or at least of average size, there is no average size among insects, and their giants and midgets are perfectly natural. And such giants and midgets they are! Perhaps the author of *Gulliver's Travels* had been observing insects before he wrote his fascinating tales, and got his ideas from them, for had he observed some blundering June bug surrounded and overwhelmed by tiny ants, he could not have described the scene more vividly than by his story of his hero among the Lilliputians. And had he imagined the sensations of an ordinary grasshopper that chanced to find itself among the giants of its kind in distant Africa, the poor creature would feel as small and helpless as Gulliver felt among the inhabitants of mythical Brobdingnag. But the Brobdingnagians were a good-natured, peaceful lot of giants and had no desire to dine on Gulliver, whereas the grasshopper giants of Africa would instantly gobble up their American cousin and would find him such a tiny crumb that they would scarcely taste him, for these immense locusts or grasshoppers of the Dark Continent are so huge that they feed upon mice and small birds. Un-

doubtedly they are the biggest giants of the grasshopper family, yet they are no larger in proportion to our common hoppers than are many other giant insects compared with ordinary every day members of their families. I would not care to state which is the largest of all the butterflies, for there are many butterfly giants, the owl's head butterfly already described being one of the largest. But there is no question that the Atlas moth, mentioned in the preceding chapter, is the real giant of the moths. Both of these insect giants, as well as the bird eating grasshopper, are natives of tropical lands, and it is an interesting and rather curious fact that in most cases the insects, as well as the trees and other plants, and the reptiles, grow to much greater size in the tropics than in the temperate zones, while the reverse is true of man and many other forms of animal life. Perhaps you wonder why this is so. The reason is that plants and insects are the most ancient forms of all life upon the earth and appeared and flourished and developed countless groups and characters when our planet was enveloped in a hot, and humid atmosphere and tropical conditions extended to what are now the polar regions. And even when, millions of years later, reptiles appeared upon the scene and gigantic dinosaurs and other colossal monsters stalked over the earth, most of our world was still what we of today call tropical. To be sure, as the earth cooled and cold and temperate zones were developed, many of the insects and reptiles, as well as the plants, adapted themselves to conditions and surroundings and survived the cold weather. But countless other forms were unable to stand the changes and disappeared from all portions of the earth other than the tropics, where, in much the same environment as that which existed when

their remote ancestors flourished and grew to immense size, they still survive and attain colossal proportions. Man and the other warm blooded creatures did not appear until millions of years later, however. They came into existence when there were various zones of temperatures, and Nature saw to it that they flourished best under conditions quite the opposite from those which were best suited to the insect world. And it was well that it was so. Our farmers and fruit growers, our gardeners and in fact all of us have a bad enough time fighting insect pests as it is. But think what it would be like if we were beset by hordes of mosquitoes as big as cockroaches, if the fields of grass and clover were the haunts of grasshoppers as large as robins, if Gypsy moths had six inch wings and sawyer beetles in our forests were nearly a foot in length. Yet it is merely a matter of latitude and of climate which prevents such insect foes from overwhelming us. In fact many of our commonest insects are almost identical, except in size, with tropical species, left-overs, as it were, of the giants of the dim and distant past, who have become relatively small, weak and stunted in our colder climate. The three-horned ground beetle, the common rhinoceros beetle, the timbermen, the cicada, the carpenter bee and the cockroaches, with many another insect both beneficial and injurious, are but small editions of tropical creatures so much like them that the latter appear like our familiar insects viewed through a powerful magnifying glass. For that matter some of our insects still retain some memory of their former tropical homes, and driven by instinct periodically seek the warm and humid lands of their remote ancestors. Such is the case with the common monarch butterflies which gather in the autumn in enor-

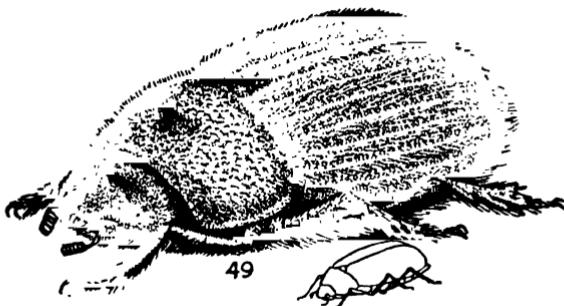
mous numbers and migrate southward. As if summoned by radio messages, they come from every direction moving slowly towards the far distant tropics, gathering recruits as they advance, until at times their vast numbers darken the sky, and when they alight to rest, the aggregate weight of the millions of individuals actually breaks large limbs from trees. Perhaps at such times, they imagine themselves back in the days before man appeared upon the steaming earth, and so have no fear of human beings. Be



this as it may, when thus migrating in incalculable numbers, these butterflies, ordinarily wary seem immune to fear and may be picked up and handled without making any attempt to escape. To be sure, the strange migrations of these butterflies harm no one but themselves, countless numbers meeting with disaster on their journeys, for they are not injurious to cultivated plants and the few trees they injure amount to little or nothing. But suppose the

reverse movement took place and equally vast hordes of some giant tropical insect should suddenly decide to migrate northward and pay us a visit!

What chances would our forests stand if an army of millions of giant tropical sawyer beetles should suddenly sweep down upon us? Yet these giant tropical sawyers with their overgrown front legs, (Fig. 48), seem small by comparison with the South American Elephant beetles and the Goliath beetles of Africa. These are probably the largest giants of the insect world if judged by length, and



with the long horn-like proboscis projecting from the head and thorax they may be as much as twelve inches long from tip to tip. But when it comes to all around size and bulk they must divide honors with the Hercules beetles of the West Indies. These insects (Fig. 20, Frontispiece) are truly stupendous creatures with great silvery gray bodies speckled with black, a massive thorax armed with a huge, tapering, curved "horn" and with a second "horn" on the head. They vary greatly in size however, some being scarcely larger than their northern cousins while others attain a length of nine or ten inches. Only the male beetles possess the horns, the females being quite ordinary but

enormous beetles looking not unlike gigantic June bugs, (Fig. 49). The males, however, are most dangerous and fearsome in appearance, and anyone unfamiliar with them would feel certain that one's hand or finger caught between the two long horns would be most painfully pinched and cut, to say the least. But these giant beetles are the greatest of insect bluffers. Not only are they utterly incapable of exerting sufficient pressure to squeeze one's finger uncomfortably between their "horns", but they do not even attempt to do so when given an opportunity. In fact, they are perfectly harmless and may be handled with impunity even by a child, although they cling so tenaciously with their immense hooked feet that they may prick one's skin slightly if allowed to walk over it, and may tear and scratch like bramble thorns if dragged forcibly away. They are quiet, peaceful beasts, too, despite their ferocious appearance, and live upon the sugary sap of trees, often congregating by dozens or scores where the sap is oozing from some forest tree, and drinking so deeply of the fermenting sap that they become inordinately drunk and reel and stagger about, or fall helpless to the earth like a crowd of tipsy sailors. At such times it is very easy to collect them, and once when on one of my expeditions to the West Indies, I secured nearly one hundred specimens by placing vessels filled with a mixture of molasses, sugar and rum in the forests where the giant beetles are found.

In order to study their habits I kept several of the beetles alive, tethering them with a cord tied about the thorax, and one of these captives was the cause of a most amusing incident.

I was living in a native house in the mountains and a number of the villagers had gathered about, as was cus-

tomary every evening, and by the flickering light of a candle were telling creepy, hair raising tales of ghosts, jumbies, Obeah and other uncanny and supernatural happenings.

Finding my tobacco pouch empty I stepped into my room to secure more, leaving the door ajar, and as I reached for my tobacco box in the semi-darkness I disturbed one of my tethered Hercules beetles. The next instant there was a whirr like a gust of wind as the huge insect took wing, and attracted by the candle light, headed through the open door for the room beyond. At the sudden and alarming sound of great vibrating wings the already tense and nervous people screamed, shrieked and cowered, fully convinced that one of their own Jumbies had put in an unexpected appearance. The next moment they were in total darkness, for the giant beetle had reached its goal and the draught of its wings had snuffed out the candle. But the insect had also reached the end of its tether and was whirring in circles and looping the loop like a miniature aeroplane over the heads of the terrified people. Yelling like maniacs, praying, cursing and screaming they huddled together, while from time to time a piercing shriek rose high above the hubbub as the confused and blundering beetle swooped down and roared past the face of some woman or girl. Shaking with laughter, I at last found the cord, hauled in my struggling captive, replaced the beetle in a box and closing the door of my room, stepped forward and lit the candle. Never have I seen such abject terror on human features as was on the faces of the trembling cowering crowd when the candle flared up. They were livid with fright, their teeth chattered, their eyes rolled wildly, and it was over an hour be-

fore they calmed down. Even when I explained what had occurred, the people at first refused to believe me, declaring that I had been mistaken and that the intruder had been a real Jumbie. Not until I demonstrated the truth by producing the beetle and allowing it to fly across the room in full view were they convinced. But once they realized what actually had happened they took it as a good joke and laughed over their own terror. But they were always careful thereafter to make certain my door was tightly closed before they began telling ghost stories of an evening.

CHAPTER X

BROWNIES OF THE INSECT WORLD

I HAVE often wondered if when Palmer Cox created his droll and fascinating little Brownies he did not pattern them after the funny Leaf-hoppers, whose faces are most comically elfin. Wherever there are plants or trees the leaf hoppers are at home, and while you may never have noticed them particularly, once your attention is called to them and you examine them closely to learn something of their habits, you will be surprised indeed, for they are among the strangest and most interesting of insects and by far the most comical. If you want to get a real laugh, look



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at these little chaps head-on through a magnifying glass, (Fig. 50). Their eyes are so keen and bright that they seem to twinkle and one almost expects to see them wink slyly. There is a line between the head and thorax which causes them to appear as if wearing spectacles, and each species wears a different kind of cap. Some are like "tams", others look like old fashioned night caps; others have ear-tabs and still others seem to be wearing dunce caps or funny rimless hats like those worn by French chefs. No two species are alike, and many have most

amazingly grotesque forms, while others are the cleverest of masqueraders. There are species which actually carry portable radio antennae on their roof-shaped backs and nearly all of them are the champion jumpers of the world.

Frequently they leap ten or twelve feet at a time or about five hundred times their own length! Imagine what it would be like if people could leap over half a mile at a single bound which would be about the same distance in proportion to our size. There would be no need of trains or aeroplanes under such conditions, but the little hoppers are not content with being such prodigious jumpers but can fly as readily as they can leap. When all other means fail, they depend upon their legs and wings for their safety, but most of them trust mainly to masquerading as something else, and only jump or fly as a last resort.

Of course you have noticed the little patches of froth so common on grass, weeds and foliage during the spring and summer, and known commonly as Frog spittle or Cuckoo spittle. But did you ever examine one of the frothy masses closely in order to discover what causes it? The next time you see one, push the suds-like material carefully aside with a bit of grass stem or a tiny stick, and beneath the froth, clinging to the stem of the plant, you will find a little green insect with big bright eyes and frog-like head. He, too, is one of the insect Brownies, and while only a baby he is a most interesting chap known as a Frog hopper. Like the full grown hoppers these larvae feed upon sap, but as the youngsters are soft and cannot leap far, they resort to a most novel means of concealment by whipping the sap into lather with their tails and hiding within it.

In some localities where the frog hoppers are very

numerous the sap of the trees tapped by the countless young hoppers sometimes drips to the earth, and at one time there was a prevalent belief that if these trees, which were called "rain trees", were planted in dry situations they would water the ground about them. No doubt, as the cuckoo is often known as the Rain bird or Rain crow, the name "Cuckoo spittle" was bestowed upon the hoppers' frothy hiding places owing to the old belief in the rain trees.

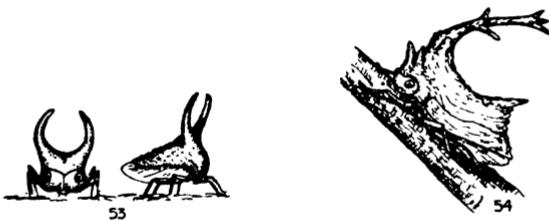
Young Mr. Frog hopper is not the only member of the



leaf hopper family that hides secure from prying eyes, however. If you search the rose bushes or blackberry vines carefully, you may find a number of the insect Brownies with long, curved, sharp pointed horns upon their backs so similar in shape and color to the plant's thorns that when the insects squat motionless upon the stems they are indistinguishable from the real thorns (Fig. 52). It is a most surprising thing to touch a rose thorn and see it suddenly come to life and vanish in a prodigious leap. Other hoppers bear two horns upon their backs and when viewed head on look so much like miniature buffaloes that they have been named Buffalo hoppers, (Fig. 53), while still

others which appear most grotesque with warty, branching, antler-like growths above their shoulders are perfectly concealed when at rest among the twigs and excrescences of the plants on which they feed, (Fig. 54).

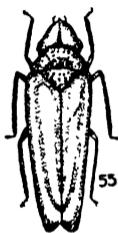
But there are many species which are hornless and being pale-green are difficult to discern among the leaves, while still others are gayly clad little creatures. Some of these are most conspicuously striped in contrasting red, yellow and green, while there is one patriotic hopper who always wears a real Uncle Sam costume of red, white and blue stripes, (Fig. 55).



"But what about the hoppers with radio antennae?" you ask. "That sounds interesting, but where's the joke?"

Truly there is no joke about it. For a long time scientists have been inclined to think that the insects, as well as other creatures, are able to communicate by means of some form of vibratory waves, in other words by radio. Only by this theory can many puzzling facts be explained, and all the experiments conducted have strengthened the belief, until now it is a pretty well established and accepted fact. In no other way, for example, can we explain the marvelous, almost incredible powers of communication of many insects. A female moth emerges from her pupa in a breeding cage in a closed room of a house miles dis-

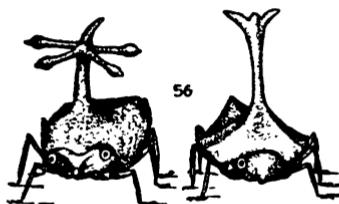
tant from woods or fields, and almost immediately the male moths begin to appear. How do they know that she is there? How do these males, flitting among the flowers in far distant fields and shady forests, know that a female has come from her cocoon within a certain room in a certain dwelling in a certain town ten or twenty miles away? And how do they find their way unerringly from all directions, against strong winds, to the identical house and room where the newly arrived female is awaiting them? There is but one logical answer—by means of radio.



How does a wandering foraging ant far from all others of his kind send word to his fellows that he has discovered a grain of sugar or some other tidbit, and bring them swarming by hundreds to the spot? Unless he has the power to send forth vibratory waves which the others understand, it is inexplicable. On one occasion I made a number of experiments to determine if possible whether insects do possess radio sending and receiving sets. I was in Central America and had secured several big sawyer beetles. One of these, a female, was placed under a glass dish and several males were placed in an open box over ten feet distant. For a few moments the female moved about her glass prison seeking an exit. Then satisfied that

she was surrounded by some invisible barrier, she stood motionless—raised her long antennae and moved them slowly back and forth in almost a complete circle. A moment later the males came hurrying from their box and gathering about the glass butted their heads against it, scratched with their feet and strove excitedly to reach the captive within.

Replacing them in their box I moved them to a different spot and placed the captive female in the opposite direction from that she had occupied before, but the result



was the same. Then I snipped one of the antennae from the female beetle's head. Again the males approached, but they seemed uncertain, searching about, crawling this way and that and only one finally arrived beside the upturned glass dish. Here, to my mind, was pretty good evidence that the antennae served much the same purpose as a radio compass to guide the males to the female. I then amputated the other antennae and found, as I had half expected, that the males paid no heed to their imprisoned sister until placed within a few feet of her and in plain view. This simple experiment proved to my satisfaction that the beetles communicated by radio or vibratory waves, and it is a simple matter for anyone to carry out a similar test and draw conclusions from the results. But

this is not necessary, for delicate radio receiving sets have been made which actually pick up and amplify the vibratory waves sent out by insects, although of course they are mere meaningless sounds to us. And if you do not believe that the little insect Brownies carry aerials on their backs, examine some of those such as are shown in Figure 56. If those posts with their cross-arms and knobs are *not* radio antennae what are they? But after all, is it any more amazing or remarkable for a tiny insect to be equipped by Nature with radio devices than for another to bury itself from sight in lather he makes, or for another to realize that his high, pointed back is much like a rose thorn and to pose as one, never making the mistake of clinging to a stem with his imitation horn pointed in the wrong direction?

To my mind it is far more interesting and remarkable to find insects exhibiting real intelligence in their battle for existence than to find them using vibratory waves as a means of communication, for while their "radio" language is natural and instinctive, and in most cases is limited to simple signals and calls, it seems as if real intelligence and true reasoning powers must be required for an insect to make use of the colors or form given him by Nature in order to frighten or to fool his enemies.

CHAPTER XI

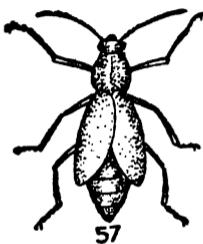
HOW INSECTS PLAY HIDE AND SEEK

DID you ever realize that the whole animal world is ceaselessly playing a game of hide and seek? Not a game for pleasure, but a serious game of life or death in which the hiders, when found, forfeit their lives. The woodpecker tapping on a tree trunk, the woodcock boring in the mud, the warblers and vireos in the trees, the cocky, little wrens in the brush piles, the bobolinks and meadow larks in the fields, and even the robins on the lawn are all playing the game and are busy from morning until night searching for the hiders. Ever since the world began, birds, quadrupeds, reptiles, fish and insects have been hiding from their foes, or concealing themselves the better to obtain their prey, so it is not really surprising that through countless millions of years they have developed wonderful habits, forms and colors to aid them in keeping out of sight. As insects are the most numerous of all forms of animal life, and as they are the natural prey of more enemies than any other class of land creatures, they are the most expert of all hiders in this life and death game of hide and seek. In fact had they not become true specialists they would have been completely exterminated long ago, which would have been a great calamity to the world, even if some people may think it would have been a blessing, for without insects the world and its life, as we know it, could not exist. To be sure there are many insects which do not

join in the game. Insects which are quite able to take good care of themselves under ordinary conditions and can defend their lives with savage jaws or poisonous spines and stings, while others are so distasteful that they have few enemies to endanger their lives and have no need to take part in the game. Instead, many of them are most conspicuous and flaunt gaudy or distinctive colors or forms which serve as danger signals to keep off, like a red flag on a load of explosives.

Perhaps you wonder, if this is so, why such insects have not increased and multiplied until the world was overrun with bees, hornets and stink bugs. But Nature has seen to that. Even the bees and hornets are gobbled up by king-birds, martins, swallows and other birds, and the perky bold bluejay considers the nauseating stink bug a dainty morsel. But the main reason why such insects have not increased beyond all bounds is because their young are defenceless creatures and have many enemies from whom the parents seem powerless to protect them. You might think that baby hornets or bees were pretty safe from harm and that it would be a bold and reckless enemy indeed who would dare invade a hornets' nest or a bees' hive in order to destroy and devour the youngsters. But strangely enough, the worst enemies of these armed warriors and their broods are timid, defenceless insects who sneak into the nurseries and gorge themselves on the grubs, like burglars entering the homes of human beings. But no burglar with his kit of tools has ever yet entered our houses by way of the air or passed safely through our front doors riding on the back of the rightful owner. Yet there are insect burglars who do both. These are the queer insects known as Blister beetles, (Fig. 57). Climbing up

the stem of some flower the young beetles hide among the petals until some blundering bee comes along. Then as the busy bee gathers pollen, a beetle larva crawls from its hiding place and clings fast to the fuzzy body of the bee. Presently off she flies carrying the young beetle hitch-hiker on an aerial joy ride to her home. There he drops from his living air ship's body and crawling into the cells helps himself to the bees' eggs which he pierces with his sharp, powerful jaws. But after a time he apparently tires of an egg diet, for he sheds his skin and his jaws with it



and comes forth in a new suit with a mouth adapted to eating honey on which he gorges himself. Having no further use for eyes he again wriggles from his skin and becomes little more than a sightless eating machine, until at last he burrows into the earth, and transforming to a pupa sleeps through the winter. Another insect which steals rides on bees is the Oil beetle. But unlike his cousin, the blister beetle, this chap is a careless sort of hobo hitch-hiker and sneaks aboard the first winged transport that appears. If he happens to tangle his feet in the coat of a bee all is well and he has nothing further to worry about. But if he steals a passage on a hornet, he may find the tables are turned and that the young hornets dine upon him.



58 Viceroy caterpillar and his "blind" 59 Viceroy caterpillar's tunnel 60 like a withered leaf 60A the Viceroy's chrysalis 61 Pine Tree Sphinx larvae 62 the smilax counterfeiter 63 amazing mimics 64 the orchid murderer

It surely does seem strange that insects as intelligent in many ways as are the bees should be so dull and stupid when it comes to protecting their young, but as I have said, if the young of hornets and bees were as well protected from enemies as are their parents there would be far too many of their kind. But there are many insects whose young are just as well or even better protected than are the adults and oftentimes these are among the most expert and remarkable players in this strange game of hide and seek.

I have already described how the viceroy butterfly mimics the monarch in order to fool its enemies. But if the viceroy's young were not well protected from their enemies the butterfly's masquerade would not save his race from being wiped out very soon. The caterpillars, however, instead of bluffing their way through life by masquerading as poisonous or distasteful insects, follow a very different method, and play a most marvelous and interesting game of hide and seek from the time they come from the eggs until they hang themselves up and transform to pupae. As soon as the tiny caterpillar is out of the egg it begins eating the leaf of the poplar or willow tree on which the eggs were laid. But unlike other hungry young caterpillars the little chap does not devour all of the tender leaf but is very careful to let a tiny fragment remain at the tip, (Fig. 58, Plate IV). A very clever chap he is to do this, for the bit of shriveled leaf attached to the midrib looks so much like the baby caterpillar, and is so conspicuous, that any hungry bird or insect enemy would most certainly be attracted by it and would mistake it for the real caterpillar who—tricky fellow that he is, is farther down the leaf hiding snugly in a little tube he has con-

structed, (Fig. 59). But as he grows larger and can no longer fool his foes in this way, he resorts to an even more remarkable ruse. Shedding his skin he appears in a new costume, a coat of brown and greenish black splotched with dull white. Thus clad, he curls up on a leaf and becomes such a perfect imitation of a bird's dropping that you might pass him by a dozen times and never give him even a second glance, (Fig. 24, Frontispiece). It is one of the most remarkable of masquerades yet the Viceroy caterpillar seems to realize that his make believe may be found out if he keeps it up too long. So once again he sheds his skin and takes on a fresh disguise. This time he is all snuff brown with a touch of green here and there, and when at rest he suits his position to his colors and form and poses as a partly dead and withered leaf, (Fig. 60). By this time he is a good sized caterpillar and having escaped countless enemies by his many disguises and his cleverness in using them, he decides to try still another, and shedding his skin for the last time as a caterpillar he blossoms out arrayed in pale greens, white and dull olive with the two long rough horns on his shoulders dull-brown. "Now find me if you can" he seems to challenge as he rests motionless on the bare midrib of a leaf on which he has dined, and pretends to be the edge of the leaf itself, (Fig. 25, Frontispiece). Perhaps some sharp eyed bird detects the counterfeit and the little masquerader comes to the end of his game. But if not he seeks some convenient spot, hangs himself up by the tail and transforms to a chrysalis. But by this time playing the game of hide and seek by pretending to be first one thing and then another, has become a real habit not to be lightly cast aside, and even as a pupa it still persists, for the viceroy's pupa ap-

pearls merely a fragment of ragged brown leaf swaying in the breeze, (Fig. 6oA).

The habit of posing as a bit of the leaf on which they have dined is quite common among caterpillars, but the funny humpbacked caterpillars of the *Schizora* moths are not satisfied with this, but eat out little hiding places in the edges of leaves and snuggle closely into them, bending up their heads and tails to fit the curved incision so that the humps on their backs appear like the serrated edge of the leaf. Moreover, their colors, usually green, brown and yellow, are so arranged that they exactly counterfeit the partly withered and dead edges of an injury to a leaf, (Fig. 6, Frontispiece). If you have ever examined the leaves of oak, chestnut, wild cherry and other forest trees you must have noticed the queer swollen irregular patches of dull orange and brown caused by gall insects.

But the chances are that many of these which you have passed with merely a casual glance were really caterpillars, (Fig. 8, Frontispiece). These queer chaps which appear like animated beech nuts more than insect larvae when they are moving about, are known as *Slug* caterpillars and are the young of pretty little moths mottled with green and chestnut-brown. Nearly all of the many species of these caterpillars pose as galls or other imperfections on leaves and in every case the insect's form and colors are perfect counterfeits of the injured portions of the plant on which it feeds, and would not serve as a masquerade on another kind of tree. Very often, however, these larvae are not confined to any one tree and the same species may be found on oak, chestnut or birch. But you would scarcely recognize the little chap on the oak as the same species as the one on the chestnut or birch, for in each case the larva

varies in color and markings to match the diseased portions of leaves of its particular tree. Another common caterpillar which plays the game of hide and seek most cleverly is very similar in form to the larva of the puss moth already described. But instead of being a bugaboo and scaring off its enemies or spitting in their faces, this caterpillar protects himself by resting motionless on the centre of a leaf where his form and colors render him almost indistinguishable, (Fig. 7, Frontispiece), while the caterpillar of the Pine Tree Sphinx blends perfectly with the needles, (Fig. 61). Many of our caterpillars belonging to the "measuring worm" or "inch worm" group or Geometrids, have their forms and colors designed by Nature to imitate twigs or sticks. Even the tiny species living on grass, weeds and small bushes, rest with their slender bodies rigidly extended and pass readily for mid-ribs of leaves eaten away by insects, while the larger members of the family are among the most expert and remarkable of imitators. Not only do they assume the positions of bare leafless twigs when at rest, but in color and form they are perfect imitations, while to add still further to the deception, each irregularity, each ring of bark on the genuine twig is reproduced on the body of the caterpillar while its head is exactly the shape of a terminal bud, (Fig. 4-4, Frontispiece).

But perhaps the oddest and strangest of these caterpillar hiders is the weird looking chap shown in Fig. 62, who poses as the twisted stem of a bramble smilax with tendrils and thorns complete.

Almost as skillful as their caterpillars at this fascinating game are the butterflies and moths themselves. Several of our most brightly colored butterflies have the under

surfaces of the wings dull grayish or brownish so that when at rest the insects seem merely bits of dead leaves, and some even have silvery or white markings of irregular shape to imitate tears and holes in the real leaves. But these are mere amateurs compared to the Kalima butterfly of India. A truly gorgeous creature with its wings gleaming with metallic blue and green and tipped and edged with orange, this butterfly, (Fig. 18, Frontispiece), is a most conspicuous object when in flight, but the instant it alights it vanishes as if by magic. There is something almost uncanny in seeing one of these magnificent butterflies flitting in the sunshine one moment and the next instant completely disappearing. The whole secret lies in the form of the butterfly's wings and the colors and marking on their under surface, plus the attitude which the insect assumes when at rest. Not only are the wings dead-leaf color, but they are so marked that when folded they appear to have a midrib and veins exactly like those on a real leaf, and as the folded wings have precisely the form of a leaf and the butterfly seems to know just how and where to alight in order to vanish, he is almost invisible among the leaves, (Fig. 19, Frontispiece). In fact in life they are even more perfectly hidden than they appear in my drawing for they tuck their legs and antennae out of sight whereas I have shown these purposely.

Although this butterfly is usually considered *the* champion of his race, yet on one occasion when in Central America, I came upon a bevy of butterflies which fully equalled, and to my mind excelled, the kalima. Thread-ing my way through the deep forest late one afternoon I lifted an obstructing vine aside and stood staring in amazement. Where an instant before, there had been a

trailing vine covered with leaves there was merely a bare rope-like liana while all about me the dimly-lit air was filled with fluttering butterflies, gorgeous insects with their long slender upperwings banded with black and gold and their under wings flashing with scarlet and green on a background of black velvet. But only for an instant did they flit about in the half-light. Singly by twos and threes and in groups they returned to their roosting place upon the vine within a few feet of where I stood watching them with the most intense interest. Alighting upon the bare liana stretched between two trees they folded their gaudy wings so that only the lower surfaces colored with shades of olive and green were visible. But they were not satisfied with this simple imitation of leaves. Moving about, turning and posturing, sometimes flitting off to alight in another spot, crawling here and there, opening and closing their wings like a group of ballet dancers at a rehearsal, the butterflies formed and reformed in clusters, some clinging to the bodies of their fellows for support, until fully satisfied that their camouflage was as perfect as possible, they remained motionless and before my eyes the leaf covered vine again barred my way, (Fig. 63). Here indeed was a marvelous thing. Not a single butterfly taking advantage of its natural form and colors to pose as a leaf, but scores of insects cooperating to produce artificial foliage on a bare vine where a solitary butterfly, or several, would have stood out like sore fingers as the saying goes. How did they know how to work so perfectly in unison? What strange instinct or high intelligence had taught them that for self protection they must pose together and in groups? And how, by what sense

or power of observation, had they learned exactly how the natural leaves of the particular liana were arranged, how they grew in certain shaped clusters and how they sprouted from the stalk? It was a puzzle beyond human mind to fathom, and being careful not to disturb the astonishing creatures I detoured and went my way filled with wonder at the marvel I had seen.

You need not travel to the tropical forests of Central America or to East Indian jungles to see such marvels, however. Our own Underwing moths or more properly Catocala moths, are almost as skillful adepts at the art of self effacement as are the butterflies I have mentioned. They are not at all rare and are great favorites with young insect collectors owing to their beauty and the brilliantly colored red, yellow, pink, rose, orange or deep crimson lower wings banded with black, (Fig. 10A, Frontispiece). On summer evenings they often enter houses attracted by the lights; they flutter about electric lights on country roads, and quite frequently when you are wandering through open woods you may catch a glimpse of one of these moths flitting swiftly away, its gaudy underwings flashing most conspicuously, only to disappear suddenly and most mysteriously. Where did it go? you may wonder. If you have sharp eyes and patience you may find out, but don't search among the leaves or on bushes or weeds for him. Instead, walk carefully towards some tree near where the moth vanished and keep your eyes fixed upon the trunk. Perhaps nothing will happen, but the chances are that if you approach one tree after another a bit of lichen-covered bark will suddenly come to life and taking wing will materialize as the handsome cato-

cala moth, which will vanish as magically as it appeared when it alights upon some neighboring tree, (Fig. 10, Frontispiece).

Wonderfully designed for playing their game of hide and seek are these moths. Not only are their upper wings marbled and streaked with soft grays, browns and dull olive to exactly match the surface and color of the bark upon which they rest with their bright-hued under wings concealed, but when in flight the latter help to protect them, for any hungry bird swooping down to gobble them up, will be attracted by the bright colors and will snap at these only to find a useless bit of the insect's wing in its beak as the moth vanishes. Moreover, each of the many species of the catoclas has its upper wings colored and streaked to match the surface of some definite resting place. Some are dark colored and conceal themselves on oaks or pines. Others resemble lichens and rest on dead logs or stones where lichens grow thickest, others are pale gray and select weathered fence rails or posts on which to rest, while one or two species are pure white and black to correspond to the bark on the white birch trees, (Fig. 11, Frontispiece). Difficult as it is to detect these moths when at rest, it is even more difficult to find their funny looking caterpillars, for these are as expert hiders as the moths and are so similar in colors and form to the rough bark of trees on which they feed that they even baffle scientists, (Fig. 12, Frontispiece), who never yet have been able to find and describe the larva of many of the catoclas.

Clever and remarkable as are these moths, butterflies and caterpillars I have mentioned, they are all outdone

by other insects belonging to other orders of the insect world, many of whom are so weirdly formed and so strangely designed by Nature that it is sometimes difficult to believe they are really living creatures. Such insects are the Walking sticks, (Fig. 5-5, Frontispiece), which are quite common in summer and autumn and at times appear in great numbers. Long and slender, with stiff jointed bodies, long angular legs which seem always to be a bit unmanageable and getting in their owners way, and slow and deliberate in their motions these weird insects look more like animated twigs than living creatures and the moment they are frightened or disturbed they "freeze" and stand motionless scarcely distinguishable from a cluster of dry sticks. Moreover, they change their colors with the seasons; in spring and summer they are greenish and dwell among the foliage of trees and brush, but as summer wanes and autumn draws near they gradually grow brown or gray until, with the first frosts, they fall to the ground among the dead leaves, dressed in russet. Even the eggs of these strange insects are camouflaged and appear so much like the seeds of plants that they have been mistaken for such and planted by botanists who hoped to find some unknown form of vegetable life sprouting from the earth above the eggs.

There seems little resemblance indeed between these walking sticks and cockroaches or grasshoppers, yet they belong to the same order of insects, known as the *Orthoptera*, and if you examine a walking stick carefully you will find there are undeveloped wings upon its back. Although our northern species' wings never grow beyond the pad stage, there are big tropical walking stick

insects with fully developed wings, and you can imagine what a strange sight it is to see a bit of stick suddenly take wing and fly away.

Another near relative of these walking sticks, and a member of the same order, is much more familiar, for on late summer and autumn evenings it may be heard everywhere, endlessly repeating its strange chant of "Katy did, Katy didn't" and ceaselessly contradicting itself. Though you may hear dozens of these insects arguing about Katy until the bushes and trees seem alive with them, yet they are not so commonly seen, for the Katydid is a confirmed player of hide and seek. In fact she couldn't help it if she tried, for Nature has given the insect wings of green veined like a leaf and when at rest amid the foliage she blends perfectly with her surroundings. But there are certain species of katydids who are among the most perfect of mimics. Not only do these have leaf-like wings like those of the common katydids, but to make the imitation more perfect their wings bear spots and markings exactly like those caused by injuries or disease upon real leaves, even to the holes made by tiny caterpillars, (Figs. 1-1, Frontispiece). Yet these insects seem quite commonplace by comparison with their tropical cousin shown in Fig. 2 of the frontispiece and most appropriately known as the Walking leaf. Whereas the katydids must depend upon their wings and attitudes for concealment and camouflage, the walking leaf goes forth clad in imitation leaves from head to foot. Its wings are perfect artificial leaves, its legs are hidden by broad leaf-like projections, the stout body seems merely another leaf, and as the insect is leaf-green throughout it is next to impossible to believe it is a living creature and not a

cluster of leaves, until it moves. Perhaps no other order of insects can boast of so many and such highly specialized mimics as the *Orthoptera* with the walking sticks the katydids, the walking leaves and the grasshoppers, as well as the mantis, all adepts at playing the life and death game of insects' hide and seek. Moreover, many of these are seekers rather than hiders, and don their amazing disguises in order to more readily secure their prey as well as to escape the vigilant eyes and hungry jaws of their own enemies. Prominent among these is our old acquaintance, the praying mantis. The mantis leaf-like wings and coat of green and his long twig-like neck are an excellent camouflage to protect him from his bird enemies, and they are equally useful in preventing him from being seen by the insects on which he feeds. Our mantes, however, are simple-minded creatures and are content to hunt their prey, whereas one of their cousins, a big mantis of Borneo, has found an easier and more certain way of filling his hungry stomach. Instead of wearing green and passing himself off as a leaf, he wears a coat of as many colors as the famous garment of Joseph, and transforms himself into a living flower.

If you were to see him at rest you would never suspect that he was alive, for in shape, markings and colors he is the counterpart of an orchid blossom, (Fig. 64, Plate-IV). Thus camouflaged he feels quite safe from bird enemies, and resting motionless with poised upraised talons, he lies in wait until some butterfly or bee espies the counterfeit bloom and hurries towards it for a sip of nectar, only to be seized and devoured by the unsuspected masquerader.

In my opinion, this insect should be awarded the first prize in this game of hide and seek, for he hides and seeks at the same time and is as expert and as successful in doing one as the other.

CHAPTER XII

THE INSECTS' UNDERTAKERS

ONE morning a man was walking in his garden and came upon a dead mole, but before he could secure a shovel, and return to bury the creature, he was called to the telephone and later forgot all about the matter until the following morning. Then, carrying a spade, he made his way to the spot, but to his surprise the defunct animal had vanished. Probably nine men out of ten would have let the matter end there, thinking that some stray cat had relieved him of the job of turning undertaker for a mole. But this man was a scientist, and noticing a little mound of freshly-turned soil where the mole had been, he decided to investigate. Carefully digging away the earth he found the missing mole three inches below the surface, and, beside the body, two large orange and black beetles.

The mystery of the mole's disappearance was solved, the Sexton beetles, as they are called, had buried the creature, and had thus provided a supply of food for their young, for the larvae of these strange insects live upon carrion.

It seemed incredible that two little beetles could actually have dug a grave and buried the mole three inches under ground during the night, and the scientist decided to learn just how it was possible and how the beetles accomplished such a feat. For it *was* a most marvelous

feat, as great a feat in fact as if two men, finding a dead elephant, should dig a grave big enough to bury the enormous body twenty feet beneath the earth in the space of twelve hours. And so amazing and so interesting did the scientist find these insect undertakers and their work that for nearly two months he carried on his experiments and his studies. During that period, of fifty days to be exact, the two sexton beetles buried twelve bodies, of birds, frogs, fish and quadrupeds.

Compared to these insects the proverbially busy bee is a real lazybones, the sexton beetles being probably the most industrious of all insects when it comes to downright hard, unremitting labor. And in their work they appear to exhibit real intelligence and reasoning power, whereas the bee goes blindly on, driven by instinct, and is completely confused and at a loss when any new or unforeseen problem arises. With her it is the same old routine job gathering pollen, carrying it to the hive, building combs and storing honey and she is little more than an animated machine, or rather one cog of a machine, working in unison with hundreds of her fellows. But the little sexton beetles face an entirely new problem with every dead body they find. No two bodies are exactly the same size. Never twice are the bodies in exactly the same position, and in nearly every case the earth to be excavated differs from other localities. But you can't stump a sexton beetle, or rather a pair of them, for they always work in pairs, no matter how hard you may try. They will even attempt to bury a good sized dog or a cat, and I don't doubt that they have had many a try at dead cows and horses or human beings for that matter. Moreover, they succeed far better than might be expected when they

tackle such herculean undertaking jobs, and I have seen a dead cat buried almost wholly from sight by them. But ordinarily they confine their labors to dead creatures which they can bury. And if the ground where the corpse rests is stony, or too clayey or hard for grave digging, they will manage to drag and haul the body to some spot where the soil is suitable.

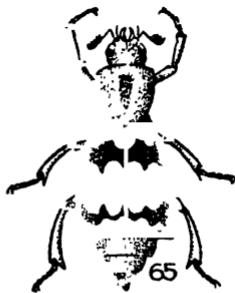
One observer tells of having watched a pair of these beetles who had found a dead bird on a concrete road. For a time they tried their best to dig away the solid concrete, but at last, finding this was a job utterly beyond them, they began dragging the defunct sparrow towards the edge of the road where they selected a spot of soft loose earth for their cemetery. Another entomologist placed a dead mouse in a low bush several inches above the earth and watched results. For a time the sexton beetles were in a quandary. How could they carry out the undertaking job which Nature expected of them when the body to be buried was suspended high above their heads? Again and again the beetles moved about the dead mouse beyond their reach, stopping now and then to stare upwards, wriggling their antennae, seemingly conferring with each other and discussing the problem, exactly like a couple of contractors making a survey of some building to be razed, and conferring as to the best manner of tackling it. Finally, having apparently reached a definite decision, the two beetles climbed the bush and commenced pulling and tugging at the mouse. But the astonishing part of their actions was that they did not go blindly at it nor waste their efforts. As if they had figured it all out beforehand, and assuredly and unerringly as though they were working with a blue print to guide them, the

insects devoted their efforts entirely to the parts of the mouse which were actually caught on the twigs and paid no heed to the portions which merely rested on the branches and leaves. And in an astonishingly short time the body had been released and dropped to earth. Then, descending to the ground, the two triumphant beetles began digging the creature's grave.

It is fascinating to watch these beetles at their task of burying a dead body. First of all they will crawl over it, examining it carefully, often descending to the earth and walking around the body as if estimating the size and depth of the grave required. Then, having ascertained this matter, they will begin digging with their heads and feet, the male beetle doing most of the work, throwing out the earth from underneath the body, until it begins to settle into the excavation. If the dead creature catches on the sides or ends of the grave, which is always a snug fit, or fails to drop into the grave properly, the little orange and black undertaker will crawl beneath it, tugging and hauling at fur or feathers. Frequently, too, he will climb onto the body and will stamp upon it with his feet or jump up and down striving to force it into the grave. With only his head and feet for pickaxe and shovel the insect sexton is handicapped and works slowly. But he labors steadily and surely to make up for lack of speed. It is hard, tiresome work, too, and after laboring steadily for a time, the beetles will "spell" each other, one working while the other rests, relaxing in a most human manner with cramped legs stretched out and head leaning against a pebble or even the side of the dead animal. But patience and perseverance overcome all obstacles, as the precepts in our school books assured

us, and gradually, as the grave is deepened the body sinks below the surface until the beetles, satisfied that it is buried deeply enough, fill in the grave and cover the body from sight. Then, the female having deposited her eggs beside the corpse which will supply food for her ghoulish brood, the insect undertakers go crawling away in search of more bodies to be buried.

Almost anywhere at any time during the summer you may watch these little grave diggers at their work, for



although seldom seen except when at their undertaking jobs, the sexton beetles are always about, and in order to see and study them it is only necessary to place a dead bird, a mouse or some other small creature where the beetles can find it. There are a number of species of these sexton beetles, some red and black, others yellow and black, still others orange and black and some deep steel-blue and yellow, but they are always recognizable, (Fig. 65). But do not confuse them with the common Carrion beetles. These are large black or dark blue beetles which possess some strange, almost uncanny power of detecting a dead body and appearing suddenly and as if conjured from the air almost as soon as any creature dies. But these beetles, (Fig. 66), are not undertakers. Their larvae,

like those of the sexton beetles, live on carrion, but it makes no difference to them whether or not the dead body is properly interred, and having done their duty by placing their eggs on the body, they leave it to the more sanitary sextons to be buried.

Just why the sexton beetles should become voluntary grave diggers and undertakers is one of the mysteries of the insect world, for the nearly-related carrion beetles get along just as well without so much trouble and labor, and so do the Rover beetles, (Fig. 67), who also live upon



carrion and lay their eggs in dead animals. Somewhat like miniature sexton beetles in shape and color, these insects, when frightened or molested, have a funny habit of bluffing, and turning up their tails pretend to be ready to sting, but they are as harmless as their sexton cousins.

Another beetle or rather tribe of beetles, which are in a way insect undertakers, are the so-called Tumble-dungs. Big, stout, clumsy fellows, often clad in shining iridescent armor, and frequently with horns upon their heads, these odd creatures spend a large portion of their lives laboriously rolling balls of dung over the surface of the earth, (Fig. 68).

To those unfamiliar with the habits of these beetles

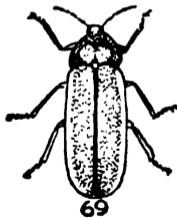
it seems a most purposeless occupation, but to the beetles it is most important, for the spheres of dung, often many times the size and weight of the owners, is the food supply for their young when they hatch from the eggs laid in the ball. Neither do these insects roll their spheres aimlessly about, but having built them to satisfactory size by the same process that a small boy rolls a huge snowball, the beetles dig a grave and bury the ball out of sight.

It seems strange indeed that human beings should have once regarded these lowly, dung-rolling beetles as sacred, but such is the case, for the well known scarabs of the Egyptians were merely a species of tumble-dung beetles. Just why they should have selected these insects to be glorified and worshipped is a mystery no one has ever satisfactorily explained. But perhaps the Egyptians, who regarded burials of so much importance and took so much pains to mummify the bodies of their own dead, saw in the tumble-dungs a kindred spirit and a symbol. But they would have done better had they chosen the sexton beetles if this were the case. For that matter, if they had wished to deify an insect because of its burial customs they should have selected the bee for when some creature, too large to be removed, dies within the bees' home the insects mummify the body. Gathering resin from trees they work it into a waxy varnish with which they completely cover the body, thus encasing it in an air tight shroud which, even if it does not prevent decay, effectually seals it and prevents any unpleasant odor from escaping. Perhaps after all the bees are the most expert of insect undertakers, for in a way they thus embalm the bodies of the dead instead of burying them.

CHAPTER XIII

INSECTS THAT CARRY LANTERNS

THERE is an old story of two green Irishmen, newly arrived in America, who were tramping along a country road in search of work one night when they were beset by hordes of mosquitoes. For a time they fought the insects, which were entirely new to them, but at last the pests became unbearable, and one of the men suggested that they might escape their tormentors by hiding in a



nearby haystack. But still the mosquitoes buzzed and bit. Then one of the men, peering from his hiding place, saw the flashing lights of fireflies. "Sure, Pat," he exclaimed " 'tis niver a bit of use tryin' to hide from thim—they do be afther us with lanterns."

The insects with their "lanterns" which the Irishmen saw were doubtless the common little beetles erroneously called "fireflies". These are soft, rather frail looking creatures with dull colored bodies and heads marked with orange or yellow (Fig. 69). There are many species, but

all are similar in form and color, although they vary considerably in size and in the amount of light they emit as well as in its color, some giving a clear white light, others a yellow or amber glow, others a greenish light and still others a light of a pinkish tint. Their larvae also possess lights and are commonly known as Glowworms a name which is also applied to the wingless females of some species. Sometimes it is the male beetle who carries the lantern and his mate is lampless or nearly so, in other cases the lady may be the light bearer, while in many species both males and females carry equally bright lights. Although we rarely think of them other than as pretty little creatures whose lights flash and twinkle on summer evenings, yet the fireflies are perhaps the greatest mysteries of Nature, for no one has ever been able to discover how they produce their light. Great scientists, chemists and countless other investigators have devoted years of study to these tiny insects, striving to solve the riddle, to explain the mystery of the fireflies' light. But the little beetles have baffled them all. Perhaps you wonder why it should be of any importance to discover the secret, but it is difficult to name a discovery which would be of greater importance or of greater benefit to mankind. If the mystery could be solved, and man could duplicate the means by which these insects produce light just think what it would mean.

It would revolutionize the lighting systems of the world. It would mean cold light of enormous intensity produced with a minimum of power and waste or perhaps without power. In proportion to its size the firefly produces more light than our most powerful dynamos, yet it does not generate a single degree of heat in doing

so, and the mechanism or means by which the light is produced is all contained within the tiny space at the tip of the abdomen of the insect. At one time it was thought that the light was some form of phosphorescence. But that theory has been cast aside by many who claim that it is produced by some means akin to electricity, while still others believe it is more similar to the emanations of radio-active chemicals. Viewed in the daytime the light area of the insect's body appears as a pale-greenish patch of phosphorescent material, and as the light-making portions of all insects which produce light appear the same, we must assume that the waxy, dull whitish-green material must hold the secret. But neither chemical analysis of the material, which is rather spongy or cellular, nor microscopic examinations, have given a clue as to why or how the light should be produced or by what means the insect can turn it on or shut it off at will.

If one single group or class of beetles produced this mysterious light it would be remarkable enough. But the strange power is not confined to one genus or one family or even exclusively to the beetles, but is common to many kinds of insects, although the beetles are the most numerous and most luminous of the insects with lanterns.

Bright and flashing as are the lights of our northern fireflies, they are mere sparks compared to the gleaming lights of many tropical beetles. Most of these are members of the click-beetle or snapping-beetle family and it is a strange fact that while snapping-beetles are very common in the north, and some of their larvae, known as Wire worms are luminous, yet none of our northern snapping-beetles possess lights when in the adult state. Even stranger is the fact that the tropical light-giving

snapping-beetles have two eye-like spots upon the thorax which emit brilliant light, (Fig. 21, Frontispiece), and that some of our northern snapping-beetles have almost identical spots which are not luminous, (Fig. 70). Why, we wonder, did Nature provide tropical snapping-beetles with a lighting plant and leave the northern members of the group to fly about in darkness with the headlights on their backs mere dummies?

But whatever the reason, Nature made up for our snap-



ping-beetles' lack of lights by giving those of tropical lands lights of incredible power and brilliancy. No one who has never visited the tropics can imagine such fireflies. And even those who have visited tropical lands and have never been in the jungles have no adequate idea of these wonderful insects.

Unlike the lights of our little fireflies, those of the big tropical beetles glow steadily, although the insect may dim his headlights until they are scarcely noticeable or may turn them on with such power and brilliance that ordinary newspaper print may easily be read by the

light of a single beetle held above the page. In many places in South America the natives use caged fire beetles for lanterns, and on my expeditions in South and Central America and the West Indies I always keep two or three of these luminous creatures in a small bottle to serve as a flash light at night when I wish to look at my watch. In Costa Rica and other countries as well, the ladies use these big "cucujos" for ornaments in their hair or on their clothing, securing the beetles by means of tiny gold chains or cords attached to the insects' "waists" and with the other end fastened to a pin. As the beetles crawl about, flashing their radiant lights in the dark hair of the women or on the lace of their garments, they are very beautiful and appear like living jewels, for the lights are of various colors—white, green, yellow or red—according to the species of the insects.

Although when crawling about or when at rest, the brilliant light of these beetles shines from the eye-like spots upon the thorax, the entire body is luminous, and it is the motion of the insects' wings in flight—alternately hiding and exposing the glowing abdomen beneath the wings, which gives the effect of flashing lights.

No one who has watched thousands of these insects flitting about the edge of a tropical forest or in the vegetation bordering a jungle stream will ever forget the sight. There is nothing like it on all the earth, no sight to equal it, a sight as indescribable as it is wonderful.

It is not surprising that when the Spaniards approached the southern coast of Cuba and saw myriads of these great fire beetles twinkling and flashing on the shores they mistook the insects for Indians with firebrands and

named it Cienfuegos, or the place of a hundred fires, although Milfuegos or a thousand fires would have been more appropriate.

On another occasion the fireflies or rather firebeetles served the Spaniards a mighty good turn. This was when Sir Thomas Cavendish was stealthily approaching a Spanish settlement trusting to a surprise attack to win a victory. But seeing the big fireflies moving about, he and his men mistook them for torches in the hands of the Dons and thinking his approach had been discovered and the Spaniards were prepared to resist, he abandoned the attack and returning to his ships sailed away.

Remarkable as are these great tropical insects with their brilliant lights, the most wonderful of all and the most surprising as well, is the larva of one of these big beetles. Several inches in length, this caterpillar-like creature carries a whole row of brilliant greenish-white lights on either side of its body, while a reddish light gleams faintly from the tip of its tail and twin golden-yellow lights flash from its head.

As the insect crawls among the weeds or grass, twisting and turning on its erratic course it is the exact counterpart of a Lilliputian railway train, and throughout the Guianas, in Venezuela and Brazil, in fact wherever it is found, it is always known as the Railway worm, whether the name is in Spanish, Portuguese, Dutch, French or English. Only the native Indians, who of course never even heard of a railway until long after the white men arrived, have a different name for this strange insect. They call it the Metacusi worm. As Metacusi is the name of an Indian dance in which the dancers carry torches

and form a procession that twists and turns in imitation of a huge serpent, the Indians' name for the strangest of insect light carriers is just as appropriate as that bestowed upon it by the white men.

engineers, soldiers, police, doctors, servants, slaves, nurses, undertakers and sanitary officers. There are ant hospitals and cemeteries, ant playgrounds and nurseries. There are paved highways and long tunnels made by ants which would be a credit to any of our engineers. There are ants who build bridges, ants that herd cattle, ants that cultivate farms, ants who raise mushrooms and ants that keep pets. There are even ant beauty doctors and masseurs while all ants carry combs about with them and never



think of starting the day's work without first going through a thorough washing and combing process, (Fig. 71).

Although all ants have most interesting and usually most remarkable habits, and although you may learn a great deal of their lives by watching any of our common ants, yet the most amazing ants are certain species that inhabit the tropics, for like most insects, the ants are most numerous and attain larger size and more unusual habits in warm climates than in the temperate zone. But you need not journey to the tropics in order to discover some most astonishing things about the ant colonies near home. Turn over any old stone or log and you will usually find ants, and nine times out of ten, you will find them scurrying madly about picking up their eggs or their helpless larvae in their jaws and carry-

ing them to safety. In fact the first thought of the ants is to protect their young, a fact which is known to nearly everyone, although few persons know how carefully and tenderly the young are guarded or that the youngsters have regular nurses constantly attending them, as well as special nurseries where they are reared, with doctors in attendance. In fact no human babies, not even the famous Dionne quintuplets, were ever more carefully and hygienically reared than are the young of most ants. In every ant community there is a special corps of workers whose sole duties are to care for the young or in other words are nursemaids.

In rooms especially constructed the young are reared. When the weather is dry and pleasant the babies are taken to the surface and given an airing, and in damp weather they are carried from the lower nurseries to drier rooms higher up in the nest. And when the pupae hatch into six legged ant youngsters their nurses feed them and teach them their duties and how to behave until they are able to care for themselves. They even have hospitals for sick or injured ants, and if a member of the colony has some disease it is not unusual for the ant doctors to isolate the patient. You may laugh at the idea of ant doctors and think it a joke, but if so you are wrong, for many ants have doctors as well as surgeons.

Moreover, they are far more sensible and more humane than human beings, for if an ant is mortally wounded or is so injured that the creature will be a cripple for life, the ant surgeons do not prolong its agony and sufferings but immediately put the injured ant to death. But if only a leg is broken or injured the limb is usually amputated and the patient carries on as usual.

But don't imagine that the ants' doctors carry little black bags and shiny instruments about with them. Ant doctors and surgeons have no need of these, for Nature has given them a whole set of instruments in the shape of razor-edged jaws and mandibles with which they can nip off a broken leg or decapitate another ant as neatly as you please. You may think it funny and amazing that ants should have nursemaids and doctors, but how about beauty specialists and masseurs? Yet ants have both, and when some weary ant stretches out and is smoothed, rubbed, patted and massaged by another ant it exhibits every symptom of enjoying the process as much as does a human athlete after a strenuous field day. It is even more amusing to see an ant being combed and brushed and "beautified", for while all ants carry natural combs upon their legs, combs which are almost exactly like our hand combs with both fine and coarse teeth, and comb themselves often, yet like human beings they sometimes prefer to be "beautified" by others than themselves and will submit to long "treatments" although it must be admitted that no one has yet observed an ant getting a permanent wave or having its eyebrows plucked. But that may be because they have neither hair nor eyebrows.

Although ants are usually regarded as the most industrious and most active of creatures yet many species of ants depend upon slaves to do all the work. While we may see the ants scurrying and hurrying about busy at a score of tasks, they may be merely the slaves of other ants who are resting and taking life easy and never doing a stroke of work within their underground homes. In fact some of these are so wholly dependent upon their slaves that they are unable to feed themselves, and if placed in a jar

with sugar they will starve, but if a black slave is placed with them he will at once begin feeding his masters. Yet despite this, the helpless reds are able and willing to fight and take part in the slave raids.

Oddly enough, the ants' slaves are always black ants and the masters red ants, so that in this way, too, they are much like the human race. And just as the Arab and other slave traders raided negro villages and killed the warriors and carried off the women and children to be sold as slaves, so the red ants raid the nests of black ants and carry off the young.

Naturally the black ants do not stand passively by and allow the raiders to carry off their children. They are valiant fighters and terrific battles take place between the reds and the blacks. But just as the superior intelligence and superior weapons of the white men enabled them to triumph over the black savages, so the superior intelligence, or at least the superior military ability of the red ants usually results in a victory. Like all sensible beings they believe in preparedness, and long before the actual attack is launched their scouts go over the ground, studying routes and hiding places, obstacles and every feature of the area about the blacks' nest and no doubt obtaining much information as to the numbers and strength of their intended victims. And when finally the red army sets out it takes the poor blacks by surprise and at a great disadvantage. Nevertheless the blacks sometimes win and drive back the invaders with tremendous losses. No quarter is shown, the wounded are promptly put to death and often devoured, and the victorious black warriors are left unmolested for a time. But usually it is the other way about and the reds win. Then off they go to their under-

ground city carrying the eggs and young grubs and pupae of the blacks with them. In their own nurseries the young slaves are as carefully reared as are the red babies, and when at last they emerge as full grown black ants the slaves seem to take to their bondage naturally and labor willingly and loyally, and often, when traveling, they may be seen carrying their red masters upon their backs. Unlike human slaves they are neither abused nor maltreated nor looked upon as inferiors, but are as well housed and fed as their masters and have all the rights of ant citizenship. In fact they are so thoroughly satisfied with being slaves that it is not unusual for them to become voluntary slaves by kidnapping a red queen to rule over them.

Naturally the offspring are partly red and partly black, and always the reds are regarded as the ruling class. But at times even the ants have their labor troubles. Perhaps there are ant unions and ant communists. Whatever the reason, the slaves of a colony will occasionally rise in arms and deserting the nest (often battling savagely and killing scores of their masters, as well as loyal slaves), will kidnap a red queen and establish a new colony.

Neither are black ants the only slaves kept by these insects. Several species of South American ants enslave leaf bugs and train them to serve as beasts of burden and when traveling compel the big strong bugs to carry loads upon their backs. In fact over twenty species of insects have been domesticated by the ants.

In addition to their slaves, the ants keep many household pets. Usually these are crickets or beetle larvae. Possibly the ants are music lovers and being unable to make music themselves keep their cricket pets to sing to them. But that wouldn't explain why they should domesticate

the larvae of beetles. Yet so fond of these beetle pets are the ants that they feed and care for them, carry them to the outer air on fine days and take them inside if it rains, and spend a great deal of their time fondling and stroking their odd pets, (Fig. 72). But there are a number of insects which may be found in ants' nests which are neither pets nor domestic animals but are uninvited and most unwelcome guests. Perhaps the very strangest and most remarkable of these is the caterpillar of the European Blue butterfly. In its early stages the caterpillar is quite nor-



mal and leads a respectable life feeding upon vegetation. But at a certain stage of its career its character suddenly changes. Dropping to the ground it pretends to be dead and permits the ants to carry it off to their nest.* But once there it comes to life and begins gorging itself on the young ants. Just why insects as intelligent as the ants should allow an intruder to devour their young without protest, or why they should carry the larva into their nest in the first place, are mysteries the human mind has never been able to solve as yet, but some observers claim that the caterpillar, as well as other intruders, serve as scavengers by consuming waste matter.

Although the ants' pets and these unwelcome guests

* Some observers state that the larva of the butterfly attracts the ants by exuding a sweetish substance. The first three stages of the larva's life are passed upon the flowers of thyme.

may often be found in ants' nests, the commonest insects found with the ants are the ants' cattle.

Mainly these are the little aphids or plant lice. The aphids have the peculiarity of producing a sweet substance known as "honey dew" from little tubercles on their abdomens and it is to secure this "milk" that the ants herd and domesticate them. Almost anywhere on almost any plant, you may find ants among the plant lice and if you watch them carefully you will no doubt see an ant approach an aphis and stroke the tiny creature with its antennae whereupon the aphid will excrete a drop of honey dew which the ant will eagerly swallow, (Fig. 73). But you have seen only one very small part of the ants' dairy; merely an ant cowboy taking a drink from one of his cows while he tends the herd. Moreover, the aphids in the open are grazing in their pasture. But the ants are skilled dairymen and provide excellent cattle sheds for their herds of aphids. Sometimes these are constructed of bits of leaves and other trash cemented together to form a shelter, but other ants build waterproof stables of finely woven silk, while nearly all have underground stables where the herds are kept and are fed on ensilage during cold weather, while still others construct covered roads leading from the stables to the aphids' feeding ground so that their cattle will not get wet in bad weather when they go to pasture. But undoubtedly the strangest and most remarkable of cow sheds built by the ants to house their aphid herds is that constructed by a species of Indian ant. These sheds are made by cementing the edges of leaves together and it is the manner in which this is accomplished that is so amazing. While one or two ants draw the edges of a leaf together and hold them in place

with their jaws, another ant grasps an ant larva and rubs the youngster's mouth along the edge of the seam. As it does so the larva emits a sticky gummy material which hardens almost instantly and glues the edges of the leaf firmly together. As soon as the contents of one of these living muscilage bottles has been exhausted, the larva is replaced in its nursery and another is used, until at last the seams have all been cemented and the aphids' shelter is completed, (Fig. 74).

Mainly, as I have said, the ants' cattle are various spe-



cies of plant lice or aphids, but they also obtain "milk" from some other insects. One of these is the caterpillar of a moth and when the larva is fully grown and shows signs of being about to pupate, the ants lead it to a hole in the earth wherein it is transformed to a chrysalis. It would seem almost as if the ants actually were familiar with the life history of the caterpillar and realized that when the adult moth emerged it would supply them with eggs to be reared as cattle. Another insect which is domesticated by the ants in Central America is a big leaf hopper. As these hoppers do not gather in herds and remain quietly grazing together as do the aphids, but are active creatures, roaming about singly over their food plant, there is an ant cowboy for every leaf hopper cow. As these leaf hoppers are almost black and have long curved horns upon their backs, and as their herders are medium sized brown

ants they appear like miniature water buffaloes being watched over by copper-skinned Hindu herdsmen. But mighty good and efficient cow punchers these ants are. On one occasion when I was in Panama I noticed several of these big ants' cattle on the leaves of a large weed.

A few inches from each was the ant herder, and curious to know what the six legged cowboys would do if one of their cattle should run away I touched a hopper with my finger. Instantly it leaped into the air as hoppers will and landed on another leaf several feet distant. But the alert ant vaquero hadn't missed a thing. His cow had stampeded, but he knew the direction it had taken on its jump, and without wasting time searching about, the ant hurried to the stem of the plant, descended to the ground, hustled to the plant on which the hopper was at rest, climbed up the stalk and unerringly locating the leaf "rounded up" his charge. Perhaps, had the hopper been on its proper food plant, the ant cow puncher would have allowed it to remain there. But it happened to be a different plant as the ant knew. And then followed one of the most remarkable exhibitions I have ever witnessed. Approaching the hopper, the ant pushed and nipped at it, driving it towards the stem of the plant. Not once attempting to escape by jumping or flying, the big hopper obeyed its herder, and urged on by the ant whenever it hesitated, it made its way back to its original grazing ground. For over two hours I remained there experimenting with the ants and their charges. But the result was always the same. No matter how far the hoppers leaped when disturbed, their herders found them and drove them back. How they managed it I cannot say, but manage it they did, although their feats were fully as re-

markable as if a human cowboy should unerringly locate a cow whisked off by an aeroplane and dropped in a vast forest twenty or thirty miles away.

Among many species of ants, the cowboys act not only as herders but also serve as living restaurants. Drinking the honey dew of the aphids until they can hold no more, they make their way to the busy workers and placing their mouths against those of the laborers, disgorge a meal of the honey dew stored within their stomachs. But there



is a species of ant found in our western states which goes these living restaurants one better and makes honey-jars of members of the colony. Within these ants' nests are chambers about six inches long and four inches wide and perhaps an inch in height, with the ceilings hung with scores of amber-colored spheres the size of grapes. But if you should examine these carefully you would find that the motionless globular things possessed heads and feet, and in reality were ants with their abdomens distended with honey until they look like miniature balloons. Throughout the winter these living larders remain clinging to the roofs of their cells and afford a source of food for the other ants, (Fig. 75).

Remarkable as are the ant dairymen, they are no more remarkable in their line of business than are the ant agriculturalists in theirs. The best known of the ant farmers are the Agricultural ants of our southwestern states. Although some scientists claim that these insects do not

actually sow their seed, but merely encourage and cultivate the young plants that spring from seeds accidentally dropped, yet all agree that these amazing creatures weed the ground, remove all pebbles and trash and cultivate and loosen the earth about their "ant rice" as the grass is called. When the crops ripen the ants harvest the grain and store it in underground granaries and watch over it constantly, keeping it dry, throwing away any seeds that mildew or sprout, and sunning it when it becomes damp. So long have these ants cultivated their ant rice that they have developed a class of workers known as "big heads" whose sole duty it is crack the hard grains so that the other workers may masticate them into a coarse meal, which mixed with their saliva forms a paste which is their principal food and the sole diet of their young. Far wiser than are human beings who dwell in areas liable to floods, these ants when dwelling in low ground that may be inundated, build a mound of earth a yard or so in height above their nest, with the entrance at the highest point, whereas if on dry or high ground the entrance is on the level surface of the earth. About their nests these agricultural ants clear the surface of all weeds, grass and pebbles for an area ten or twelve feet in diameter, and from this central plaza they construct broad roads radiating in every direction and extending for fifty or sixty yards. This is truly a wonderful achievement and a most stupendous labor when we consider the size of the ants. Moreover, they are not content with mere trails or paths such as most ants construct, but level and grade their roads and actually smooth the rougher spots and cover holes with tough silken pavements.

But there are other ant farmers whose habits are even

stranger and more unusual than those of the Texas agriculturalists, for these South American ants make their farms in trees in the form of hanging gardens. Mouthful at a time they carry earth high up in the trees where it is moulded and pressed together to form a large ball within which the insects construct galleries and chambers lined with paper much like that made by hornets. Then, when the strange structure is finished, they sow the outer surface with seeds and the plants supply food as well as shade. But the most astonishing part of it is that the



plants which are raised by these tree farmers have never been found anywhere other than growing on the ants' hanging gardens, although fourteen different species have been described. Where, you may well ask, do the ants secure the seeds? No one can say positively, but it is thought that these plants have been cultivated by the ants for so many millions of years that they have either developed distinct species or else that the original wild plants have disappeared, and that the seeds from one garden are so carefully gathered and stored for planting in new gardens that they never find roothold elsewhere.

Almost as wonderful as these plants, and in some ways

more remarkable, is the Ant tree of Java. The root of this tree is swollen and bulbous and is full of natural tunnels, galleries and chambers which form natural ants' nests for a species of ant which always inhabits them, (Fig. 76). In fact the tree cannot grow and thrive unless its root contains ants, while the ants depend upon the tree for existence. Here indeed is a strange partnership, yet it is no stranger than a similar partnership formed by a certain species of ant and a certain tree in Central America. The tree in this case is an *Acacia* whose trunks and limbs are covered with stout double thorns as sharp as needles and with swollen bases which give them the appearance of miniature Cape Buffalo horns. A thicket of these trees would form an almost impassable barrier owing to the terrible thorns alone. But the bases of the thorns are always inhabited by hordes of tiny, ferocious, red ants, and the instant man or beast touches the trees the ants come pouring from their nests to attack the intruder, their jaws, tiny as they are, causing the most excruciating pain. Most appropriately are they called Fire ants, for their bites are like red-hot needles or blazing coals burning into one's flesh. Beyond doubt the sharp thorns of the trees protect the ants, and probably the ants reciprocate by protecting the trees, although why trees so defensively armed should require additional protection is beyond all understanding.

That certain species of ants should have developed into expert farmers and agriculturalists is amazing, yet it is not nearly so astonishing as the fact that certain ants raise mushrooms for their food, for in the former case the insects merely encourage the growth of plants in their natural surroundings, whereas the mushroom growers

prepare artificial beds for planting and raising species of fungus where they would not grow naturally.

The most famous and best known of these mushroom-growing ants are those known as the Umbrella ants or Leaf-carrying ants abundant in the American tropics, and, wherever they occur, terrible pests to the farmers and gardeners. They are almost always in evidence everywhere except in the cities, moving steadily and rapidly in an endless procession of two columns traveling in opposite directions, every member of one column carrying a triangular bit of green leaf like a parasol over its head: those of the other column empty-jawed, (Fig. 77).



If you should follow the leaf-carriers to their goal you would find them vanishing within a low mound in a cleared space above their nest, while from other openings they come pouring out after depositing their burdens beneath the earth. So vast are the numbers of ants constantly passing back and forth that they form well-beaten pathways through grass, weeds, brush and trash, straight as a boulevard in some places, swinging in curves to avoid obstacles, zig-zagging back and forth, and sometimes extending for a mile from the nest. But eventually, if you should follow the ants' road, you would reach the scene of their labors.

And wonderfully interesting you would find it to watch the insects at their work. Climbing up a bush or tree each ant selects a leaf, and using its jaws like a pair of

scissors, rapidly cuts two converging slits which almost meet. Then, with a quick jerk, it tears the triangular piece free, and holding it above its back, hurries down the trunk and along the road towards the nest. Although the majority work singly and carry each bit of leaf to the nest as it is cut, others have discovered that team work is more efficient, and while one cuts the leaves and drops the pieces to the ground the others pick them up and carry them away. Moreover, they take turns at the work, the cutter when tired taking the place of a carrier, while one of the carriers climbs the tree to cut the leaves. It is almost impossible to conceive the amount of strenuous labor which these ants perform day after day. Very often their loads weigh twice or even four times as much as their own bodies, and not infrequently the tree or bush whence the leaves are cut is a mile or more from the nest. Why the ants should travel such a vast distance, equivalent to over one hundred and twenty miles to a man, in order to secure leaves when there are trees of the same species within easy reach of the nest, is an inexplicable mystery. Yet the ants must have a reason for their puzzling actions, and in the course of a day make scores of trips back and forth between nest and tree and tree and nest. On their journeys for leaves these ants are often accompanied by strange midgets who are incapable of cutting leaves and are apparently mere entertainers. Being weak creatures and easily tired, they are often carried to the nests on the backs of the workers. The leaf cutting ants also keep blind cockroaches as pets, and so fond of these creatures are the ants that when a queen departs to form a new colony she usually carries a baby cockroach with her. In return for the loving care bestowed upon them by the ants

the cockroaches act as masseurs and also lick the sap of the leaves from their masters' bodies.

It has been estimated that each ant travels in a day a distance which, in proportion to the insect's size, would be equal to nearly three thousand miles! Imagine a human being walking from New York to San Francisco one day and back from California to New York the next, for day after day, week after week, and carrying a load of two to three hundred pounds on each eastward hike, merely to secure material for a mushroom bed to supply food for his family and his friends. Yet that is the sole object of the ants' ceaseless work. Within their nests, workers shred the triangular bits of leaf with their jaws, mould them into tiny pellets, and with these form little mushroom beds. By this I do not mean mushrooms such as human beings eat, but a species of tiny fungus which provides food for the ants and their young, and like human mushroom farmers these ants inoculate their beds with the fungus threads. Perhaps you wonder why ants which live upon fungus grown underground should be pests to farmers. In the first place the ants' nests and clearings cover large areas of earth and the creatures permit no plant to grow about their mounds while their subterranean galleries extend for hundreds of feet, undermining the earth and making cultivation impossible. But the main reason is that the ants, although exceedingly "choosy" in collecting leaves from certain wild trees and shrubs, seem to prefer the leaves of cultivated vegetables to all others, and once they have invaded a garden or a farm they will strip the plants bare of leaves, while it is almost impossible to discourage or exterminate them. The fungus raised by these ants is never found except in their nests.

In preparing the beds the workers masticate the leaves into a paste and are careful to weed the beds when the fungus appears. Others are constantly employed pruning the fungus to prevent it from fructifying as the ants eat only the liquid that is produced on the fungus threads and which does not form after the fungus fruits. When a queen leaves to establish a new colony she carries a pill of fungus paste under her mouth and retains it there until a new nest has been formed, her eggs laid and a brood of workers hatched and able to bring in the essential leaves in which they plant the fungus spores so carefully preserved by their queen. In the meantime they feed upon the surplus eggs.

Although these umbrella ants carry immense loads, yet their heaviest burdens are feather weights compared to those which are borne by another South American ant known as the Drogher ant or Robber ant. These insects are raiders and robbers and work stealthily, like any burglars, at dead of night. In localities where they are found they are a great nuisance, for anything edible which they can find and carry is loot to these ants. They enter houses, explore shelves and pantries and steal anything and everything edible within reach of their strong jaws. Nothing is safe from them unless covered with fine wire screening, shut in ant-proof containers or isolated by being surrounded with kerosene. And the amount that a marauding band of drogher ants can carry off in a single night is almost incredible. On one occasion, while in the British Guiana jungles, my camp boy forgot to lock our provisions in their tight chest. The next morning three pounds of rice and two pounds of dried prunes were missing. The drogher ants had visited us during the night and had robbed us of

five pounds of provisions! For a single ant to carry off a grain of rice at a time was not so astonishing, and hundreds or thousands of the insects working steadily might easily have managed the three pounds. But for the robbers to have moved two pounds of prunes seemed an impossible feat.

However, they had contrived to do so, and later on I watched them do it. Fully a dozen of the big ants joined forces, pulling and tugging together, moving the fruit a fraction of an inch at a time, until they had dragged it to the edge of the shelf and with a final effort toppled it to the ground. There, hundreds of the waiting ants swarmed about it. A whole platoon seized it in their jaws, and like some strange, wrinkled, black creature with hundreds of legs, the prune went trundling off and out of sight.

It was a real engineering feat, yet a simple and primitive bit of engineering compared to the feats of many ants who construct bridges and culverts, tunnels, and even rafts. In the tropics ants are so numerous and such household pests that it is necessary to place the legs of dining and kitchen tables in cans filled with liquid. But mere water is of no use, for the ants will quickly bring bits of trash, and dropping these into the tins, will form bridges over which they pass. At times, too, they will use living bridges, several ants deliberately plunging into the water where the air bubbles, clinging to the minute hairs upon their bodies, keep them afloat until their fellows have crossed over on their bodies. Other ants have been seen to bridge wide cracks or gaps in a veranda floor by placing grass stalks across them, and it is not unusual for vast numbers of ants to ascend a small tree and by sheer weight of numbers cause it to bend until the insects can reach the

foliage on the farther bank of a stream. But more astonishing than these ant bridge builders are those which actually construct pontoon bridges. Reaching the verge of some small stream, an ant will grasp a little stick and push it into the water, holding it moored by his legs. Others then climb onto it; other sticks are launched, and little by little, the ants holding onto one another and to the twigs, a little raft is formed. Bit by bit more sticks are added, more ants swarm onto the float, and at last a pontoon bridge spans the stream. The moment it touches the farther shore the nearest ants anchor the float with their jaws, and rapidly the others disembark, until with the last ant safely across, the raft is turned adrift.

Strangely enough however, there are other ants which display even more apparent intelligence and coordination in some ways than do these clever bridge builders, yet have never discovered a means of crossing a stream.

These are the Army ants of the tropics, and in all the ant world they are the most remarkable in many ways. Utterly blind, yet they move in vast armies across the land, overcoming every obstacle other than fire or water, maintaining perfect formation, moving with military precision and like a real army having their scouts, their engineering corps, their medical corps and their fighting soldiers. No one knows why these ants, which normally wander about in small platoons, should suddenly be seized with the militant spirit, and assembling in inconceivable numbers, should start out to sweep and ravage the country for miles. All we know is that they do so; that at times armies of these ants, hundreds of yards in width and extending in a solid, closely-packed, unbroken mass of millions of individuals, appear as if by magic and sweep

across the land like a fire, consuming every living thing, every fragment of animal matter in their path. So numerous and so voracious are these big ants that horses and cattle are overpowered and devoured, and there are many cases of human beings having fallen victims to the army ants. Yet they rarely deviate a yard from their course. I have stood within a dozen feet of a vast ant army, an army so immense that the rustling of their moving bodies and the sound of their jaws could be heard a hundred yards away, and have watched the amazing sight without a single stray ant attracted by my presence.

On another occasion, when I was in the Costa Rican jungle, a small army of these ants invaded our camp during the night, and while we slept, secure in our hammocks suspended by their rough ropes which no ant will cross, the creatures left the shack bare of every vestige of meat, and completely devoured a three hundred pound tapir which I had killed the preceding afternoon, leaving only the tough hide and bones behind them.

In a way the natives rather welcome an invasion of these ants, and upon their approach move bag and baggage from their homes, knowing that when the army has passed they can return to their huts and find them completely rid of all roaches, mice, rats and vermin.

When upon the march the army ants send scouts ahead to pick the route and report obstacles to be avoided. Along either flank surgeons constantly run back and forth, and if a marcher is injured he is immediately taken aside and examined. If there seems no chance of recovery he is promptly put to death. If a leg is broken it is amputated, and if the injured ant is temporarily incapacitated he is carried to the rear and aided by others until he has completely re-

covered. When fissures, ravines or other similar obstacles are met, the ants form living chains or bridges for their fellows to cross, and although there are no officers, although no one ant or group of ants is in command, there is perfect order, perfect accord and the millions of insects move and act like a single unit.

Pages, in fact entire books, might be filled with stories of ants, for there are thousands of species, and each has its own strange, unusual and interesting habits and human-like customs, one of the strangest of which are their burial customs, for ants not only bury their dead, but have their cemeteries and quite elaborate funerals. In fact an ant funeral is almost the exact counterpart of our own, the dead ant being carried by bearers at the head of a procession of relatives and friends, and when the burying ground is reached the deceased insect is carefully lowered into its grave and covered up. About all that are lacking are the coffin and flowers, and the service read over the grave. And who can say positively that the ants do *not* have some form of service? Surely, if they do it would be scarcely more remarkable and astonishing than the ways and customs and the strange behavior of many of the ants.

CHAPTER XV

INSECTS USED FOR FOOD

THE mere idea of eating insects is disgusting to most persons, yet the vegetarian insects are among the cleanest of all creatures, and even the carnivorous species are far more cleanly in their habits and their food than are poultry. Moreover, we consider lobsters, crabs and shrimp as delicacies, yet these creatures are akin to insects and in addition are scavengers and carrion eaters.

There is an old saying to the effect that what is one man's meat is another man's poison, and this is very true of insects, for in many lands and among many races insects of various kinds are used as food.

Our own North American Indians consider grasshoppers as most delicious and nourishing food. Dried and ground into a meal they are made into a paste and either fried or roasted. Not having personally tasted these grasshopper cakes, I cannot testify regarding their flavor, but friends who have eaten them assure me that they are really excellent. And after all why not? The hoppers feed exclusively upon grains and grass, so why shouldn't their bodies contain all the essentials and the flavor of their food?

Some tribes vary their menu by making grasshopper soup, which is said to taste very similar to pea soup, while the Indians of Oregon and California prefer crickets to grasshoppers. In South America there is a species of big

sphinx caterpillar which at certain seasons swarm by hundreds on the forest trees as they descend to pupate, and these are deemed real delicacies by the Indians. Once when I was in British Guiana I found the Indians gathering these larvae and roasting them in the hot ashes of a fire. Curious to know how the caterpillars tasted, I told my camp boy to put a pot of lard on the fire, and while the grease was coming to a boil I collected a dozen or so of the big fat worms. When these were dropped into the boiling lard they puffed up and turned a golden brown and looked much like fritters. There was nothing unappetizing about them when thus cooked and I found that they tasted so



much like fried soft shelled crabs, with much the same consistency, that I clamored for more.

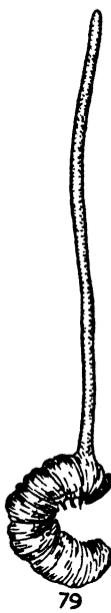
Another larva which is widely used as food in tropical America, but especially in the Leeward Islands in the West Indies, is the grub of a giant weevil beetle. These fat white grubs, which look much like enlarged editions of our common June bug larvae, live in the hearts of the buds of the Groo-groo palms and are known as Groo-groo worms, (Fig. 78). They are usually cooked by skewering a dozen or so upon a slender sliver of palm wood and are then toasted over hot coals. Thus prepared they swell and pop open like roasted chestnuts, and taste exactly like these favorite nuts. When alive they are rather disgusting look-

ing grubs, I admit, but after being toasted they have no resemblance to insect larvae. Although originally a Carib Indian dish, they are now eaten by the negroes, as well as by white men, and personally I am very fond of them. Many races, both civilized and savage, find ants a desirable article of food. The Africans eat inordinate quantities of the white ants or termites, while the South American Indians are passionately fond of the big queens of the leaf-carrying ants. At certain seasons of the year these winged queens swarm by hundreds upon the surfaces of the ants' nests, and if an Indian finds a nest with the swarming queens he will fairly gorge himself upon them. I have seen Indians standing knee-deep in an ants' nest, with the blood trickling down their legs from the bites of the vicious warrior ants, and apparently oblivious to the pain as they gathered the queens by the handful, pulling off their wings as they did so. Then, leaping from the nest and hurriedly brushing the biting ants from their bodies, they retire to some nearby spot where they munch the ants like boys munching peanuts at a circus. The queens which are so distended with eggs that they appear ready to burst, are about the size of large peas and taste very much like condensed milk, as I can state from personal experience, for many a time I have joined the Indians in their ant-queen feast, although I left the gathering of the insect dainties to the Indians.

Another ant which is considered a real treat is the honey ant described in the preceding chapter, and in some parts of Mexico no wedding breakfast is considered complete without its course of honey ants.

Even flies are eaten by many races, although they are a special breed and not our house flies or "blue-bottles",

while vast numbers of insects eggs are gathered and eaten by the natives of central Mexico. These are the eggs of a species of water boatman insect, and are laid on reeds and water plants near the margins of the lakes. They are made into little cakes and are said to have a very appetizing flavor and to be very nutritious.



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A still stranger form of insect food, although in this case it is not exactly the insect which is eaten, is popular in New Zealand. This is a fungus growth which attacks a large beetle grub. The fungus destroys the larva, and sprouting from the body just back of the head, pushes its way upwards to the surface of the earth where it appears like a slender whitish stalk, (Fig. 79). These are eagerly gathered and eaten and are said to be most delicious when properly cooked.

Strange as it seems for people to dine on grubs, beetles, flies, ants, caterpillars and grasshoppers, it is far stranger for them to eat the pupae of moths. Yet the Chinese eat the chrysalis of the silk worm after the silk has been unwound from the caterpillars' cocoons. These pupae, already partly cooked by the hot water plunge to loosen the silk, are fried in butter with the yolk of an egg added, and persons who have tried them agree that they are one of the most delicious of morsels.

But probably the most unusual insect food devoured by any human beings, and by all odds the most repugnant and disgusting, are fly maggots which are eaten by certain Negro tribes in Africa. It is not the maggots themselves which seem so nauseating, for after all a fly larva is not so different from a termite's larva or the grub of a beetle, but the fact that in order to obtain a supply of the maggots the Africans bury flesh in the ground until it putrefies and is alive with the fly larvae.

Truly there is no accounting for tastes. But very largely the question of what is and what is not fit to eat is merely a matter of custom and of example. A young white child, reared among Indians or blacks, has no qualms about eating insects or other foods which would fill the youngster with disgust if brought up among his own people. And many of the articles which we consider the most appetizing of viands and real delicacies, are regarded with horror and are nauseating to many other races. Probably, in fact positively, primitive man ate anything and everything in the form of meat which he could lay his hands upon, and deemed all good. But through the ages we have acquired tastes for certain things and distaste for others, and some-

where in the process of our civilization, we or rather our remote ancestors, decided that insects were taboo.

But what a saving it would be, what a boon to our people if we could learn to eat and like insects. How it would simplify our lives if we could go forth to the fields and garner a mess of grasshoppers for dinner.

And had our race been as fond of termites as are the natives of South Africa we might not find our houses tumbling about our ears because of the depredations of these pests, for the consumption of millions of termite larvae might have kept them under control. And what possibilities there would be in raising insects for the table! Imagine what fame and fortune an insect farmer would win were he to produce a new breed of edible cricket as large as a lobster, or a bug that laid edible eggs as large as grapes. And as for the ants, there would doubtless be specially bred honey ants each containing a whole tablespoonful of the most delicious of sweets.

But it will probably always be the other way about, and while insects will continue to dine upon us, we will never learn to turn the tables and dine upon insects.

CHAPTER XVI

INSECTS THAT ARE NOT INSECTS

THE chapter heading does sound paradoxical, and in a way it is, for although generally considered as insects, spiders are not true insects in reality, but are closely related to the crustaceans and belong to a separate family which includes the scorpions, ticks, mites and daddy-long-legs. All true insects have six legs and have the body distinctly divided into three sections, the head, thorax and abdomen, whereas the spiders and their kin have eight legs, with an extra pair of palpi for holding their prey, and have the head and thorax in one piece.

But even if, scientifically speaking, the spiders are not true insects they are among the most interesting and strangest of creatures, and from the very earliest times numerous tales, legends and fables have been woven around them. Every school child knows the story of Robert Bruce and the spider, and of course there was Little Miss Muffet who was frightened away by a spider. But perhaps the most interesting legend of all was that of the ancient Greeks. According to this myth there was once a maiden named Arachne who in a spinning competition proved herself more adept than the goddess Athena. Angered by the girl's superior skill, Athena changed Arachne into a spider and condemned her to spin forever. Because of this old Greek myth scientists gave the name Arachnida to the spider family, and while it is a most fanciful if

pretty tale it is no more fanciful than many popular ideas about spiders. Even the old verse about the spider and the fly is all wrong.

The big, fat hungry spider waiting for a fly to enter the silken parlor is usually a lady spider instead of a gentleman, for among these creatures the female is far more dangerous than the male and usually kills and devours her much smaller husband at the first opportunity. It is because of this unpleasant custom that the Black Widow spider received her name. Fortunately for human beings the black widow is not a common spider, and like all spiders she desires only to be let alone and will not bite unless hurt or molested or in danger.

Although the majority of persons are afraid of spiders, and many think all spiders bite and are poisonous, yet the black widow is the only poisonous spider in the United States. In fact there are very few spiders anywhere that are poisonous and few are capable of biting. Even the ugly hairy tarantulas which look so dangerous are almost harmless, for while they can and sometimes do bite, puncturing one's skin with their sharp-pointed palpi, yet they are not really venomous and the wound inflicted is little worse than a bee's sting.

Not only are most spiders perfectly harmless but they are really most useful creatures and true friends of man, for they destroy vast numbers of flies and other noxious and injurious insects, and when one's unwarranted fear and repugnance are overcome, they will be found most fascinatingly interesting. Even their structure is interesting and strange, for they possess most marvellous organs for spinning their silk and they are the only creatures with

two distinct sets of eyes—one for seeing at night and the other set for daytime use.

It is their habits and lives that are the strangest and most interesting features of spiders. Born trappers and hunters, the spiders are found everywhere except in the far Arctic and Antarctic regions and on the summits of the highest mountains where there are no insects.

But even where human eyes can see no signs of insect life spiders will manage to find a living, and I have frequently found spiders on the lofty summits of the Andes above the line of perpetual snow.

In their lives and habits they vary as greatly as they do in form, color and size. Among them are masons, weavers, miners, and aeronauts, as well as engineers, divers and swimmers. Some species set most cleverly designed traps with which to capture their prey; others leap upon their victims like leopards or tigers, still others trust to their speed and agility and run down their quarry; some even use a lasso, while many more spin elaborate silken webs which may be funnel-shaped, flat sheets, or geometrical in design. Of all these webs the geometrical or orb webs are the most interesting and most remarkable, and few persons who carelessly brush aside one of the structures as "just a spider's web", realize that they are destroying one of the most marvellous examples of nature's handiwork. But it would be a most dull and stupid person indeed who would not be fascinated by watching one of these orb-weavers build its lovely web. But first we must understand how the spider spins the silken strands which are used in making the webs and in many other ways. If you examine the under side of a spider's body you will see a

little group of tubelike organs, usually six in number. These are known as spinnarets, (Fig. 80), and are specially designed for forming the tiniest of silken strands, yet each of these, which are less than one five-thousandth of an inch in diameter, is made up of countless finer strands, often as many as two hundred, which issue from tiny openings at the tip of each spinnaret, coming in liquid form from a reservoir within the spider's body and hardening into silk as it reaches the air. And just as a great cable of a suspension bridge is formed by spinning count-



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less strands of wire rope together, so the hundreds of minute threads issuing from the spinnarets of the spider are joined together to form the strong, tough strands used in making the web. But the spider's spinning machine is far superior to that devised by man to spin bridge cables, for the spider can vary the size and strength of its cable at will merely by spreading the spinnarets apart or placing them closely together.

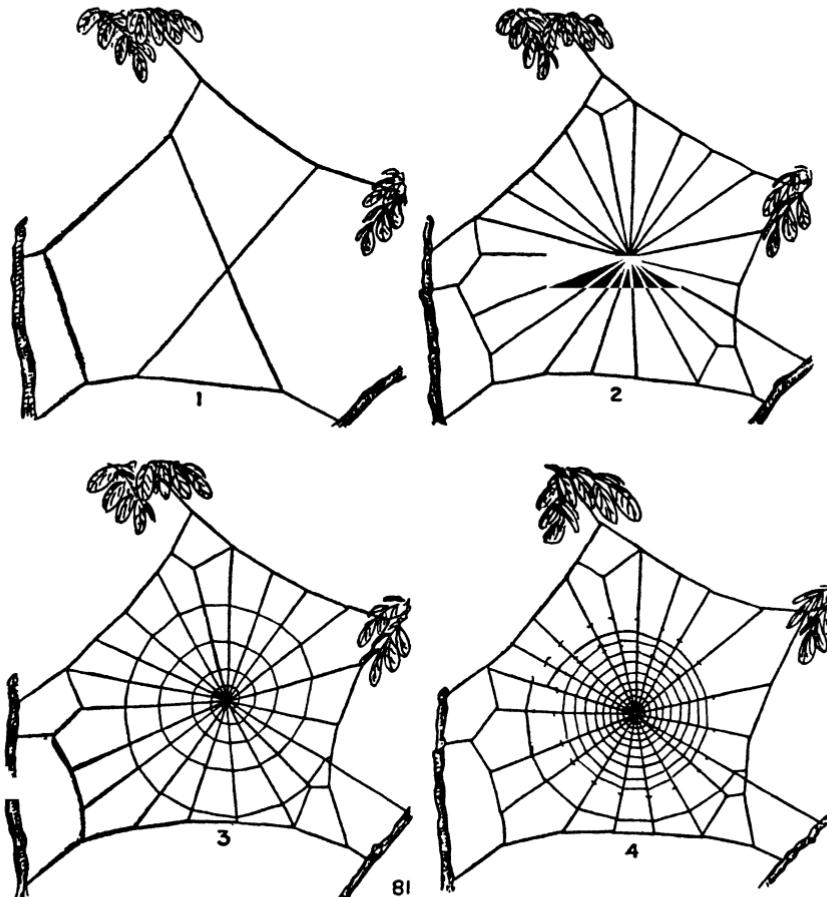
Not only can the creature spin any size of silken thread from a minute strand to a broad silken ribbon, but in addition the creature can produce dry, inelastic silk or sticky elastic silk as occasion demands. And both of these are most essential to the orb weaver when constructing its geometrical web, and are equally necessary to other web-making spiders. When the spider wishes to drop from place to place or is making bridges from twig to twig and

erecting the staging or framework of its web, it uses the dry inelastic threads, while the sticky elastic strands are used for catching the spiders' prey, their elasticity preventing the captive's struggles from breaking them while at the same time sticking to him and entangling him the more.

When the orb-weaver wishes to build one of her geometrical cart-wheel-like webs she first spins several lines from one twig, weed stalk or leaf to another to serve as ladders or staging for her convenience when moving about. Next she fastens a thread to some convenient spot or to one of the staging lines, and walks along, spinning as she goes, and with one hind foot carefully guiding the new thread and keeping it clear of the objects over which she travels. This new thread is carried around the staging until it crosses the spot which the spider has decided upon as the exact center of the completed web. Then she pulls in the slack, fastens the line securely and runs nimbly back to the centre where another line is started and carried to a point a short distance from the spot where the first line has been fastened. Again and again this operation is repeated until all the radiating spoke-like lines are in place. Then the little engineer moves to the spot where all the spokes converge and cross, and attaching a thread walks around and around in an ever-widening spiral, sticking the new thread to each spoke as she crosses it. In this way she forms a web that looks like a silken coiled spring, each turn being as far from the next as the spider can reach.

This is little more than preliminary work, for all the spider has accomplished has been to form a frame or support of dry inelastic thread, and the true web is yet to be made.

Commencing at the outer end of the spiral, the spider fastens a sticky elastic strand and traveling backwards around her framework she forms a second spiral the turns



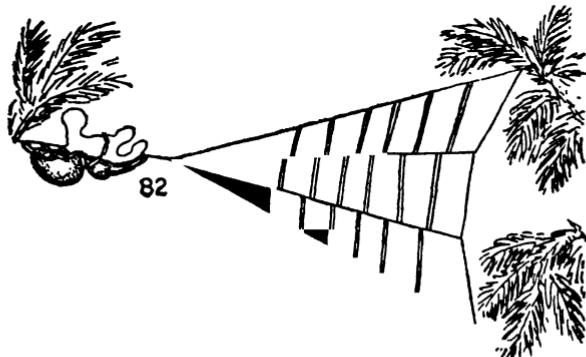
of which are close together. As she moves along with this second permanent thread she destroys the first or dry spiral leaving tiny fragments hanging here and there at-

tached to the radial spokes. At last she reaches the centre of the web and her beautiful geometrical trap is completed, the entire operation having occupied less than one hour, (Fig. 81). Now that her elaborate trap is ready all she has to do is to watch and wait for some unwary insect to blunder into it, and hiding near by among the leaves or hanging head-down from the centre of the web, the spider awaits her first meal, grasping several of the spokes with her feet so that instantly she will detect the least jar or vibration caused by an insect striking the web. And the instant the signal is given, out she dashes and with amazing rapidity swathes the captive in a shroud of broad silken ribbon, until he is helpless and looks like an Egyptian mummy in its wrappings, and Mrs. Spider can suck the unfortunate's blood or juices at leisure.

No doubt these orb-weavers who take such pains and show such true engineering skill in making their webs have found their type of trap the most effective for their purposes. But their less careful and particular relatives who are content to build flat sheets of silk upon the grass, or who construct slovenly tunnels among the weeds find their traps equally efficient, for each depends upon a different class of insects for its prey. Thus the orb-weaver's geometrical web stretched vertically between trees or plants is a deadly trap for flies, butterflies, bees and other flying insects, while the sheet spread horizontally on the lawn is an equally deadly device for capturing grasshoppers, crickets and similar small fry who dwell close to Mother Earth. Just as human trappers employ deadfalls or box traps, snares, twitch-ups or steel traps for catching their prey, so the spider trappers employ innumerable devices for their trapping. Some species make no true webs

but merely stretch a single line and hide in a silken nest grasping the tiny strand stretched before their snug retreat. This is not intended to capture passing insects, but only serves as a signal—the door bell so to speak, and the instant it is touched out dashes the spider and leaps upon the creature who has sounded its own knell.

But there is another spider which has a far more clever



method of catching its prey, for this spider uses a lasso. These are quite common among the twigs and branches of evergreen trees and at first sight they appear most simple and uninteresting triangular webs composed of four radiating lines crossed by a number of heavier double threads, the whole fastened to some twig by means of a single stout thread extending from the apex of the triangle, (Fig. 82). But if you watch one of these nets patiently, or touch it gently with a blade of grass, you will be surprised to see the whole web dart suddenly forward and wrap itself about the grass—exactly like a bolas or lasso. If you examine the supporting line carefully you will doubtless find the owner, a round-bodied little spider, hidden among the leaves, with its hind legs holding firmly

to the supporting line and its front legs grasping some loosely-coiled slack thus pulling the four supporting lines and their connecting bars taut. Here the little lasso-thrower waits patiently until some buzzing fly or blood-thirsty mosquito bumps into the simple-appearing web. Then, instantly, the spider lets go with its fore feet, and the elastic web springs forward entangling the unfortunate intruder. Then the spider draws its web tight and again and again snaps it forward, until the victim is thoroughly enmeshed and helpless and the lasso-thrower can dine in comfort.

The Magnificent spider of Australia uses an even more perfect bolas or lasso. Hanging to a foothold of web, she grasps a line an inch and a half to two inches in length tipped with a sticky globule which she swings at any passing insect. If the globule dries before an insect is captured, the spider eats it and forms a new adhesive tip to her bolas. An African spider has an almost identical habit, but swings her bolas constantly in a horizontal circle trusting to luck to strike some insect. It is a hit or miss method but usually effective.

Spiders, however, use their silken threads for many purposes other than as snares and traps. With the silk they spin their cocoons containing their eggs. Some species keep these little spheres within their webs, others attach them to leaves, twigs or beneath the bark of trees, still others place them under stones or fallen leaves, while many species carry the cocoons about with them wherever they go. When a spider wishes to cross a stream or pass from one tree to another the little creature turns bridge-builder, and spinning out a long loose thread lets it drift with the breeze until it catches on some twig or other ob-

ject on the farther side of the stream. Then, like the expert slack wire-walker she is, the spider runs nimbly across the frail cable. Sometimes the strand is used only as a footbridge, but very often it serves as the first support to a web, for spiders have learned that one of the best of all trapping grounds is above running water where May flies and other insects abound.

At times, also, the spiders use their silk to make bal-



loons and become true aeronauts. They are daring and skillful aviators, too, and carried through the air by their silken balloons they travel for immense distances, sometimes for hundreds of miles and often land on ships far out to sea.

When the spider aeronaut wishes to make an ascension, he climbs to the highest spot he can find, such as a fence post, telegraph pole, a bush or even a tall blade of grass, and here, holding by his fore feet, he stretches his body upward and rapidly spins out a thread, (Fig. 83). The free end of this line is wafted upward and away by the breeze and the warm air rising from the earth, until at

last enough silk has been spun to lift the spider's weight, and releasing his hold, off he goes, sailing gaily away through the air.

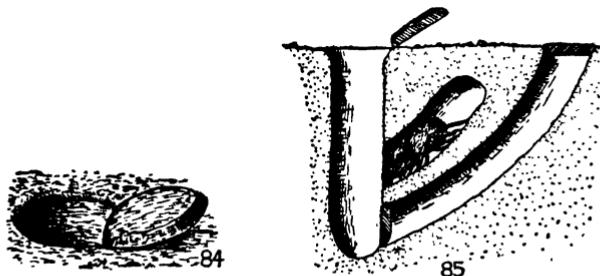
Perhaps you think that this simple breeze-borne silken thread should not be dignified by the term "balloon"; but nevertheless the spider aviator can regulate his speed and can sail in safety far more successfully than any human aeronauts in the baskets beneath the huge gas-filled bags, or for that matter with greater security than the best and biggest of our commercial aeroplanes can guarantee.

If the breeze freshens or if he wishes to reduce his speed he has only to gather in some loose silk and so "reef" his sails as it were, whereas, if he wishes to travel more rapidly or the breeze dies down, he can spin out yard after yard of silk until he drifts gently along supported by a cloud of gossamer. To be sure the spider aeronaut cannot direct or steer a course from one spot to another, but moves in the direction in which the wind happens to blow. But as he has no schedule to maintain and no particular destination and does not require a level landing field for his descent, this doesn't matter so very much. And he can descend to earth whenever he desires. If he wishes to make a landing he has only to gather in his thread until he drops slowly down and when he wants to end his flight he spins a drag-line which, like the anchor of a human balloonist, catches on some object below. Then by hauling in on this, the little air traveller pulls himself down to terra firma and cuts free the silken balloon that has carried him safely and far. These aeronautical spiders are very common, for the habit is almost universal among the young of many species of spiders, and it is by this means that they spread from the place of their birth to far distant points. Often,

on warm autumnal days we may see hundreds of the threads streaming upward from fences, bushes, grass and other objects or floating about in the air. Borne on the wings of a stiff September breeze these tiny adventurers travel swiftly, and as some always seek higher altitudes than others they are caught by various air currents and are borne in all directions. But it often happens that great numbers will travel the same air lanes, and like a flock of migrating birds, will all reach the same destination and will descend together. Several years ago when I was on a treasure-salvaging vessel anchored on the Silver Shoals between Haiti and Turks Islands, and over one hundred miles from land, thousands of these spider aeronauts descended on the ship one morning. Everywhere, from masts, rails, ropes, rigging and boat-davits silken strands streamed and glistened in the sun giving the vessel a most remarkable appearance. And everywhere the young spiders, hungry after their long journey from the distant land, overran the little ship searching out spots to spin their webs. More than twenty species were represented among the hordes of little aviators, although the majority were all of one species which does not occur in either the Bahamas or in Haiti, but is found in Florida, so we could feel certain that our spider visitors from overseas had travelled the air route from the coast of the United States nearly three hundred miles distant. Naturally a ship far out at sea is not a promising spot for spiders to find a livelihood, and as they were almost as great a nuisance as cockroaches, they were far from welcome. Countless numbers were put to death by the crew; countless more probably starved to death, yet a few survived and spun their gossamer webs in nooks and corners and by some myste-

rious means actually managed to trap enough insects to supply their needs.

Although all spiders can spin silk, yet by no means all of these creatures use their silk for spinning webs or traps. The big hairy tarantulas, and their smaller cousins, the Trap door spiders of our own country, use their silk for lining their underground homes and in forming the cleverly made doors to their burrows, (Fig. 84). These are



made of grains of sand or other material mixed with silk and are fitted with a silken hinge and are provided with a tiny silken handle or door knob so that the occupant of the subterranean home can hold his door tightly closed against intruders. Many of these mining spiders are not content with a single trap door to their homes, but for greater safety they dig one or several side tunnels, each provided with a trap door opening into the main burrow. These not only serve as sleeping quarters and resting places for their owners, but provide safe retreats into which the spider may dart when pursued by an enemy.

If the intruder succeeds in opening the main door to the underground home the spider backs into one of the side chambers, shuts the door behind him, and leaves the enemy baffled at the apparently unoccupied nest. Other spe-

cies go even farther and with true foresight dig tunnels to the surface of the earth with their openings, also equipped with trap doors, at some distance from the main entrance. Then in case their homes are invaded, they slip out the back door while their enemy is still poking about searching for the occupant of the deserted homes, (Fig. 85).

Although the true trap door spiders and tarantulas are inhabitants of the tropics and of our western plains, there are trap door spiders in our eastern states, and these make underground burrows and form tightly-fitting doors and have as interesting habits as their bigger cousins of the tropics and the plains. These spiders belong to the genus *Lycosa* and look much like miniature tarantulas, although easily distinguished by their jaws which move sideways instead of up and down as do those of the true tarantulas and western trap door spiders. In almost any dry sandy spot you may find the holes of the lycosas, but you will need sharp eyes to discover them, for these spiders are even more clever than their big western cousins when it comes to concealing their homes. Not only do they fit beautifully made doors to their burrows, but in addition they cover their doors with bits of grass, twigs, leaves or small pebbles, while one species even builds a little watch-tower of straws and twigs above the entrance to his home, the better to spy enemies and to spot his prey.

Closely related to the trap door spiders are the true tarantulas, and there are few spiders which have been the subject of so many exaggerated and impossible stories and the source of so many mistaken ideas. As I have already said, tarantulas, even the big fellows which are sometimes found lurking in bunches of bananas from tropical America, are by no means as dangerous as they look or as writ-

ers of fictional adventure stories would have us believe. They are such hairy ugly looking creatures that they inspire fear and repugnance in most persons, and fabulous tales of their terrible poison and deadly character have been the result. But neither they nor their giant cousins, the Mygales or Bird-eating spiders of South America, (Fig. 86), are really poisonous, and while they can inflict deep and painful wounds it is seldom that serious results follow their bites. I doubt if any human being was ever



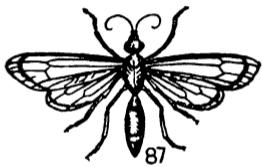
killed by one of the creatures, that is directly, although no doubt persons have died from their bites just as persons have died from the results of wounds inflicted by thorns, rusty nails or even from the stings of bees. But a person in good health and whose blood is not contaminated and who uses antiseptics promptly, has little to fear from the bite of one of these big spiders. I have been bitten a number of times by the giant mygales and never have I found the wound nearly as painful or as serious as the sting of a common yellow-jacket hornet.

Both the tarantulas and the mygales capture their prey by lying in wait and springing upon it from ambush, while

the big Wolf spiders of the tropics, which are often six or eight inches across although with smaller bodies than tarantulas, run down their prey. As they are harmless creatures and prefer cockroaches to any other food, the natives regard the wolf spiders as useful friends and as a result they are to be seen everywhere in the houses and even in the hotels. But even if one knows they are perfectly harmless and are really most useful, it gives one a rather unpleasant sensation to see a huge seven-inch spider in full chase of a scurrying roach on the ceiling above one's bed, and seemingly liable at any instant to come tumbling down.

In the north there are many species of spiders whose habits are very similar to those of the tarantulas and wolf spiders and who run down or leap upon their victims. They are ferocious chaps even if small and are arrant cannibals quite ready to attack and devour their fellows. Many of these jumping spiders are most remarkable dancers, and the Italian dance known as the Tarantella is so called because it was once believed to be the result of being bitten by the tarantula, the bite causing a madness called "tarantism" which could only be cured by continuous dancing. But the dancing jumping spiders perform their dances for the benefit of admiring lady spiders, in fact it is a courtship dance similar to that of many birds. The dancing males, however, are very careful to keep a safe distance from the spider belles, for like many spiders the females have a most unpleasant habit of killing and devouring their husbands, although many species will ferociously protect their young and some even carry their hundreds of babies clinging to their bodies wherever they go. Naturally savage and blood-thirsty creatures, the

spiders fight savagely among themselves and while fatalities often result, the battle frequently ends in a draw with both combatants so crippled by losses of legs that they cannot fight longer. But such injuries are of no great consequence for like their relatives, the crabs and lobsters, the spiders grow new legs to replace those lost or injured, and are none the worse for their wounds. It is largely because of the quarrelsome and cannibalistic habits of spiders that their silk is not used commercially. Spiders' silk is far stronger, finer and superior in many ways to that of the silk worms, but no one has ever yet discovered a means of raising spiders, inducing them to keep the peace and to



produce silk in sufficient quantities to use it in manufacturing cloth. But their webs do serve one useful purpose for they provide the "cross hairs" used in telescopes, sextants and other instruments.

Big, strong, ugly and powerful as is the tarantula, yet he lives in deadly fear of an insect enemy, a brigand of the air, a slender-bodied wasp known as the Tarantula Hawk, (Fig. 87). Like a swift, fighting aeroplane attacking a warship, the wasp darts at the huge spider, and drives his powerful sting deep into the hairy body of the tarantula. Numb and helpless from the poison, which does not kill but acts as an anaesthetic, the tarantula cannot lift a leg or move a needle-pointed jaw to defend himself, and the big hairy ogre is carried off by his winged

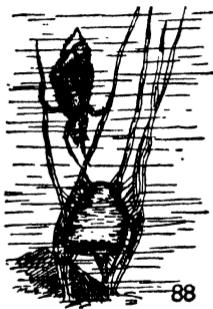
conqueror and placed within the wasp's nest to provide a supply of living but inert food for the wasp's young when they hatch from their eggs.

Possibly even the giant mygales have some insect foe who preys upon them, just as the common mud-daubers of our barns and outhouses prey upon ordinary spiders or the tarantula hawks prey upon the big tarantulas.

But if so the wasp or hornet must be a veritable monster of an insect, for the mygale is the giant of spiderdom, a huge hairy beast often measuring eight inches across its heavy legs and so strong, active and powerful that it captures small birds and rodents and will even attack a good sized snake.

But the mygale, although popularly known as the bird-eating spider is not the only spider who captures and devours birds. The great Silk spider of Bermuda spins a web so stout and strong that sparrows and other small birds are often caught in the silken trap and are devoured by the owners. It is difficult to imagine a more gruesome or terrible fate than to be entangled in a giant spider's web while the great hairy monster with gleaming eyes and pointed cruel jaws rushes forward to devour his victim. It is indeed fortunate for human beings that spiders are not as large as bears or wolves, with webs capable of enmeshing men as easily as the little garden spiders' webs trap buzzing flies. And it is equally fortunate for mankind that nature did not develop mygales or tarantulas the size of leopards or even the size of ordinary cats, or that the strange Crab spiders with their bright colors, who lurk in the hearts of flowers ready to seize and devour bees and butterflies, do not grow to the size of wood-chucks or foxes.

Strange and interesting as are the habits and the lives of such spiders the strangest of all are those which dwell upon or in the water instead of upon the land. One of these is the Raft spider of Europe who uses its silk to build floats or rafts of leaves and twigs lashed and bound together by the tiny strands. Launching the little craft on some quiet pond or pool, the spider navigator goes cruising about like a pirate in search of prey. But instead of running alongside its quarry in his strange craft, the spider pirate leaps overboard and actually runs across the sur-



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face of the water to seize some skittering water boatman or hovering insect, and return with his prize to his raft where the captive is leisurely devoured.

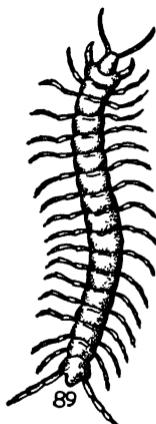
Surely, one might think, nothing could be more remarkable in spiderdom than a spider who builds a boat and can run on the water, yet the true Water spiders are even more remarkable, for these creatures, instead of navigating the surface of a pond, actually have their homes beneath the water at the bottom of the pond. Wearing a diving suit of tiny air bubbles adhering to her hairy body and legs the water spider dives to the bottom and spins a water-tight, thimble-shaped structure of silk with

a dome-shaped top and open bottom, attached to the stems of water plants or stones. Then the spider diver rises to the surface and collects a fresh supply of air bubbles which are carried down and released inside the silken diving bell, until the strange structure is filled with air. Then, crawling into her submarine home the spider diver lays her eggs and rears her young quite safe from all ordinary foes and within easy reach of the water insects upon which she feeds, (Fig. 88).

And now, while on the subject of insects which are not insects, we must not forget the spiders' cousins, the scorpions, or those other odd creatures usually considered insects by most persons, the centipedes and millipedes. Even scientists are a little puzzled as to just where to place these many-legged creatures, for while they certainly are *not* true insects, they are unquestionably more closely related to the insects than to any other group of creatures. Hence, as they cannot be placed in any other group, scientists have solved the problem by making them a separate order known as *Myriapoda*.

Although most remarkable and strange looking creatures the Centipedes and Millipedes are not nearly as interesting in their habits as are true insects or spiders. Neither can a very distinct line be drawn between the two, although as a rule the millipedes or "thousand legs" have more and shorter legs than the centipedes or "hundred legs" and are herbivorous, whereas the true centipedes are carnivorous. Moreover, millipedes as a rule will curl up and "play possum" when disturbed whereas centipedes will try to scurry to safety or will show fight. The true centipedes, also, are provided with poison fangs whereas the harmless millipedes cannot bite. While most

persons fear the creatures and regard them as poisonous, none of our northern species are in the least dangerous. In fact the common house centipede with its long active legs and slender feelers, while a rather repulsive and fearsome appearing little creature, is in reality a most useful friend, for he is harmless to man and is a deadly foe of household pests such as flies, ants, bugs, roaches and even clothes moths and the destructive "fish tail" insects



and book-worms. As the centipedes are often found running about among clothing, piles of papers or books, many persons think them the cause of the damages to property. But in reality they are merely searching for the real destroyers in order to make a meal of them.

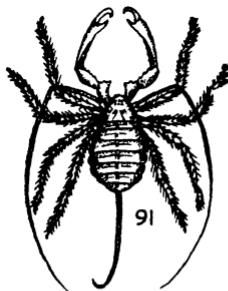
But it is a different matter with the big tropical centipedes which often reach a foot or more in length, (Fig. 89). Wherever these occur they are greatly feared by the people who will tell you that the "sting" of a centipede is fatal, and that if they crawl over one's body their feet will leave burning, inflamed wounds upon the skin.

But such statements are very far from the actual truth. A big tropical centipede can inflict a most painful wound with its pointed jaws or "fangs", it is true. But their poison is not deadly and it is seldom that a centipede's bite is more serious than the sting of a large hornet. Neither can their feet harm one, although the sensation of a centipede crawling over one's skin is most terrifying and unpleasant. Personally I have been bitten repeatedly by these big centipedes, and once, while collecting specimens in Bermuda, one of the creatures bit my eyelid. Yet I have never suffered more than temporary pain and swelling of the area about the wound and in a few days felt no inconvenience whatsoever.

Unlike the *Myriapoda* which have no near relatives among living creatures of today, the Scorpions form a sort of connecting link between the spiders and crustaceans, with the spiders verging towards the insects and the scorpions merging with the spider through various forms known as whip-scorpions, daddy-long-legs and other queer creatures.

As human beings invariably feel that the uglier and more repulsive a creature appears the more dangerous and deadly it must be, the scorpions have acquired the reputation of being most venomous and dangerous, capable of inflicting deadly wounds with their sharp "sting" at the tip of their long jointed tail, (Fig. 90). But like the centipedes and the tarantulas the dangerous-looking scorpion is not nearly as bad as his reputation, although it is not surprising that he should be regarded as a most vicious and dangerous beast. With his powerful lobster-like front claws, his flattened scaly body, his crab-like legs and his jointed tail upturned and carried above his back, and

with the needle pointed "stinger" at its tip poised ready to strike, the scorpion has all the earmarks of a beast capable of inflicting a deadly blow and to be given a wide berth. Perhaps it is just as well that he does flaunt his danger signal and is avoided, for a good sized scorpion is not exactly the sort of creature to be made into a pet or to be picked up or handled with impunity. To be sure, I



have never known of an authentic case of a person being killed by a scorpion. But I know from personal experience that even a small scorpion can make life most uncomfortable for a number of days. That happened in Peru several years ago shortly after a series of earthquakes had shaken things up a bit. Like most Peruvian houses, that in which I was living was built of adobe or sun dried mud bricks with a lathing or reinforcement of "Guayaquil" canes attached to the timber framework. Although this form of construction is excellent as a protection from serious damage and falling walls when earthquakes occur, the shocks cracked the mud walls and caused the adobe to flake from the canes. No doubt when the canes had been placed in the walls they had contained eggs and young of many insects and other creatures, including scorpions.

Safely imprisoned under the covering of adobe these had carried on, preying upon one another, multiplying and living their lives entirely unsuspected by the occupants of the houses. But no sooner was the mud covering cracked and the light of day entered their retreats than the imprisoned creatures came forth from their lairs. Beetles and other insects, spiders and centipedes, millipedes and ants appeared wherever there was a cracked wall, and with them came numbers of scorpions, undersized, pale and anaemic-looking from their long imprisonment in darkness, but as aggressive and active as any of their kind. Of course they were destroyed as rapidly as they appeared and were detected, and all cracks and openings in the walls were repaired as soon as possible.

But some were bound to be overlooked and found hiding places in out-of-the-way nooks and corners, and one night one of these unwelcome tenants crawled over my bed in its search for prey. No doubt, had I remained quiet and asleep, the scorpion would have minded his own business and I would never have known of his visit, but his feet upon my hand caused me to move and I was awakened by a sharp stabbing pain in my finger. Before he could strike a second time I had flipped the creature from my hand onto the floor where he ended his career beneath the heel of a convenient shoe. But as many an epitaph on old tombstones tells us, "though in presence gone, in memory not forgotten" and the defunct scorpion's memory was not likely to be forgotten for some time.

Despite all first aid and other remedies applied, the finger throbbed and ached. By daylight the entire hand and forearm were swollen and inflamed, and I hurried to the hospital for treatment. The surgeon in charge grinned

when he saw my discolored arm. "So a scorpion paid you a visit!" he remarked. "You're about the fiftieth one we've treated since the earthquake". Then, with a chuckle—"Didn't I hear you say that scorpions' stings weren't as bad as people thought?" he asked.

"Maybe they're not," I told him as he directed a nurse to swathe my arm in scalding-hot towels, "and I still maintain they are not fatal, but just at the present moment no one could think them half as bad as this one I've got."

The results, however, were not nearly as serious as the pain and suffering would have indicated. Within a few hours the swelling and intense pain disappeared, but for nearly two weeks the muscles of my hand and arm were almost paralyzed and felt as if my arm was "asleep" and every nerve in my left side ached as if I had been severely bruised.

As the scorpion who caused all this damage was barely three inches in length I tremble to think what suffering and injury a six inch specimen might inflict. While I still doubt if any healthy person ever died as the direct result of a scorpion's sting, I have no desire to experiment with the creatures. Like many spiders the scorpions carry their young upon their backs. They are immune to their own poison and cannot commit suicide by stinging themselves to death as imaginative writers of fiction so often describe. Many animals which customarily feed upon scorpions are also immune to their poison.

Oddly enough the true scorpions with their really dangerous and highly poisonous stings are not as greatly feared by the natives of tropical America as are the Whip scorpions, (Fig. 91). These are perhaps the ugliest and most dangerous appearing of all their group. Their flat

louse-like bodies are repulsive, their long hairy legs give them the appearance of tarantulas, their lobster-like powerful pincers seem capable of inflicting a serious injury, and as a final touch they are provided with a long slender appendage at the tip of the abdomen which appears like a most terrible sting. Any native will declare that these creatures are most deadly, that no one bitten or stung by a whip scorpion ever recovers, and nothing will induce a native to touch or even approach one of the creatures. In fact I actually believe that should a whip scorpion happen to crawl over a native he or she would die of fright. Certainly if the native succumbed it would be from sheer terror, for despite their ferocious and deadly appearance the whip scorpions are almost harmless. In fact they are just about as dangerous as a fiddler-crab. Unlike the true scorpions they cannot sting, for the fearsome looking "stinger" is merely a bluff incapable of inflicting a wound, and while they can nip one's finger a bit painfully with their crab-like pincers, they seldom attempt to do so, but are really timid retiring creatures, desiring only to be left alone and far more ready and anxious to scurry into some safe retreat than to show fight. I have collected and handled hundreds of these "deadly" creatures of various species in many lands, and never yet have I been bitten or otherwise injured by them. Yet I must confess that despite this, and in spite of the fact that I have collected insects of all sorts, kinds and sizes, and have no fear of them, yet never have I been able to overcome a feeling of aversion towards a whip scorpion. So I can scarcely blame the natives for regarding the ugly little beasts as they do, for of all creatures with which I am familiar the whip scorpions give one the impression of being the most dangerous. They are the true ogres of the insect world.

CHAPTER XVII

HOW TO FIND AND STUDY INSECTS

IF you are interested in insects and their strange habits and wish to learn more of their lives and ways, the very best way of doing so is to watch and study them. In order to do this you first have to find the insects, and that isn't such an easy matter as you may think it. To be sure, it is easy enough to find many kinds of insects—in fact the trouble is to avoid them, but unfortunately few of these so much in evidence are very interesting. Still, there are exceptions. Ants are always about and easily found, butterflies and dragon flies, grasshoppers and crickets, as well as certain kinds of caterpillars, such as the terribly destructive tent caterpillars, are all conspicuous; but for every insect you see as you stroll through the countryside, there are thousands which you miss, never suspecting their presence. A great many of these are tiny minute things, but sometimes the smallest insects have the most remarkable habits, while others are large. But large or small, insects are marvelously adept at hiding, and sharp eyes, and a knowledge of where and how to search for them are needed to find them. Practice makes perfect, however, in finding insects as in most arts, and finding insects *is* an art, and once you have acquired the knack you'll be vastly surprised to discover how many and what interesting insects you can find in a few hours' ramble through fields and woodland, meadows and swamps. You'll find it a

fascinating game also, a real game of hide and seek, and I have known persons who never had the least interest in insects, and considered them all as "bugs" to be destroyed, who, after once being induced to join in an insect hunt, became so fascinated that they devoted all their spare time to searching for insects and studying them.

One gentleman, who was an ardent golfer, became so interested in finding and rearing caterpillars, that he would interrupt his game to search a promising thicket, and when he discovered some rare or unusual specimen he would be as delighted and as proud as if he had made a hole in one.

It isn't necessary to become an entomologist or to possess a scientific knowledge of insects in order to find them interesting and to study their ways. In fact it isn't really necessary to collect insects you wish to study, but you can watch them far more closely and more conveniently, and can learn much more about their strange ways if you keep them in confinement instead of trying to observe them in their natural haunts. Moreover, if you discover some interesting insect, such as an unusual caterpillar whose life history interests you, and trust to visiting him day after day, the chances are more than even that some hungry bird or insect ogre will make a meal of your find and promptly put an abrupt end to your observations.

One great advantage of insect hunting is that no matter what sort of country is available there will be insects of some kind, for wherever there is vegetation there will be insects. But do not expect to find them abundant where trees, bushes and roadsides have been sprayed with insecticides. Only a few years ago one might wander along a country road and find scores, hundreds, of interesting

insects beside the highway. Almost any tree or bush would shelter a host of strange caterpillars; a dozen or more species of butterflies could be seen flitting about; big underwing moths were abundant on the tree trunks; beetles by hundreds could be found beneath stones and fallen limbs; wayside flowers teemed with interesting species of insects, and the cocoons of the gorgeous night-flying moths such as prometheus and cecropia, and even the lovely luna moth, were easily found. But today one may walk for miles and search the roadside plants and trees in vain. Caterpillars have almost vanished in many places, butterflies have become so scarce that they attract attention when seen, and other insects have become equally scarce.

But off the beaten track, in patches of woodland and brushy pastures, on waste land and in swamps, on meadows far from highways and farm houses, one may still find countless insects, although even in such places they have greatly diminished in numbers during the past few years.

As I have said, insects are not confined to any one type of country, but while some species frequent fields, forests and brush land equally, others are restricted to certain areas. Some are found only on the fringes of the woods, others in the heaviest forests, others in weeds or grass, others in old orchards, and so on. Moreover, as the great majority of plant eating insects are most particular as to their food and are found only on certain plants or trees, it is hopeless to search for them elsewhere, although other species very similar may be found on a great variety of plants. You must also remember that insects, like fruits and flowers, have their seasons, and often brief seasons of a few weeks, a few days or even a few hours, and are never to be found at any other times. Others appear, dis-

appear and reappear at more or less regular intervals, while still others may be found from early spring until the frosts of autumn days put an end to them. Because of this the insect hunter may follow his vocation or recreation for six months of each year, and the best of it is he never knows what he may find or when or where he may find it, which adds a great zest to the game. A plant bare of insects one day may be covered with strange larvae a few days later. Butterflies which you have never before seen may flit by scores across some field one day and vanish as if by magic overnight.

You may come upon a number of some rare caterpillars some afternoon, yet had you been a few hours later, you would not have seen a single one, for all would have buried themselves beneath the earth to pupate. And what a thrill the insect hunter feels when he comes unexpectedly upon some big handsome and rare moth—such as the gold and orange regal or the purple and buff imperial or even the pale-green luna, just emerged from its chrysalis and drying its newly expanded wings. And what is more fascinating than to find a chrysalis just ready to burst open and to watch the winged insect come forth from its horny shell?

Many, I might say most, times such finds will be made accidentally and unexpectedly by chance, for it must happen occasionally by the law of coincidence, that you should be at a certain spot at a certain time on a certain day when the miracle of Nature takes place; but chance cannot be relied upon.

It is rather difficult to describe just how to find insects, but there are certain tricks of the trade, as one might say, which will be of great help. Search the under sides of

leaves, and if looking for caterpillars, watch out for partly eaten leaves. Some larvae remain at or near the spot where they have fed while others move some distance away and remain motionless clinging to the stem of the plant, to the trunk of a tree or among uninjured leaves. So if you find freshly eaten leaves but no caterpillar near don't abandon your search but examine the leaves, stalks and branches round about. Many larvae which live on weeds, such as thistles, golden rod, asters and on tall grass, feed mainly at night, and during the day descend to within a few inches of the earth where they rest upon the stem of the plant. Dead trees, the crevices beneath bark, old stumps and rotten wood are all excellent spots in which to find insects. Other species live beneath stones and logs or among dead leaves and even in deep moss. If you find leaves rolled or fastened together look within, for an insect of some kind dwells there and until you are an expert you never will know whether the little hiding place contains a spider, a fly larva, a beetle or a caterpillar. Many strange and interesting insects, especially beetles, may be found by raking over dead leaves and spreading them on a piece of white cloth. Many others may be found in decayed fruit, under cow dung and about carrion. But by far the best way to find interesting and strange insects, unless you are searching for large fry such as caterpillars and butterflies, is to "beat" a field or a meadow where the grass and weeds grow tall and rank. For this purpose you will require a beating net. This is a net of strong cotton cloth such as heavy cheese cloth, attached to a strong stout iron hoop such as the hoops used for crab nets, fastened to a rather short stout handle. The net should be almost cylindrical but slightly wider at the bottom than at the open-

ing, and the bottom should be made square across and not rounded or conical. Armed with the net, and carrying an old bed sheet or a piece of white cloth four or five feet square, walk slowly across the field, swishing the net back and forth through the weeds and grass, sometimes across the tops of the growths, at other times near their roots, until you have walked several hundred feet or until your arms are a bit tired. Then, by giving a half turn of the hoop, close the net and spread the strip of cloth upon the ground, and holding the net over the centre of the sheet dump the contents upon the cloth. Of course there will be quite a pile of grass seeds, broken flowers and other trash, but there will also be a regular menagerie of all sorts of insects. There will be dozens of grasshoppers of various kinds, crickets brown and green, lady beetles and ugly-looking assassin bugs, young katydids and lace-wing flies, a few angry bees and perhaps some irritated wasps and hornets; funny leaf hopper brownies by the score, hurrying terrified beetles of many kinds which you never before have seen, and probably a few caterpillars and moths with a small butterfly or two, in addition to many spiders and ants. In fact there will be such a host of insects that you will be unable to watch or collect even a small portion of them before they run, hop, fly or crawl away out of reach. It will simplify matters a great deal if you sprinkle a few drops of benzine or choloroform on the net before emptying it. If choloroform is used most of the insects will recover in a few minutes none the worse for having been put to sleep. Benzine or gasolene will kill most of them but some usually recover. But don't worry about them, for there are plenty more in the meadow, and an abundance of other interesting creatures will still remain upon

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the cloth. If you are merely interested in finding and watching insects you can spend an hour or more watching those upon the sheet, while if you are collecting specimens for study in confinement or to preserve, you can pick and choose those you wish and place them in collecting boxes or jars. But in either case you will be amazed to find what a world of teeming life the meadow grass and weeds conceal, and every time you beat a few hundred feet you will secure new species. Beating along the edges of woodland or the low bushes and weeds beside some little-used road will reveal many interesting forms of insect life, while an entirely different assortment may be obtained by beating the plants and low bushes of a swamp. But be careful not to beat a blackberry thicket or brambles or you will need a new net.

Another most excellent way of collecting insects is to beat the branches of trees and bushes while holding an open umbrella upside down beneath them. You will be surprised to find how many and what strange insects you can secure in this way, even when the foliage appears bare of all insect life. Walking sticks and caterpillars are often obtained by this method for insects that cling tenaciously to branches or leaves are dislodged by the jarring blows of a heavy stick striking a branch.

A square of white or black cloth may be substituted for the umbrella if desired, but the umbrella has the great advantage of being serviceable as a catch-all in spots where brush, long grass or other obstructions make it impossible to spread a cloth. Moreover, it is always ready for use and may be carried about as you beat and tap the branches without the bother of spreading a cloth each time.

If you plan to collect specimens for study at home, or to rear, you must be careful to obtain a supply of the insects' food plants. If you find them upon leaves or resting on trees or plants you may feel fairly certain that they are on their food plants, but if you secure them by beating the only way you can learn what they eat is to try them with various plants growing in the locality where you found them.

Also, if you expect to keep your finds alive you must have proper jars or boxes in which to carry them. Bottles and jars are cumbersome and inconvenient, and while small bottles provided with perforated screw tops are the best of containers for very small insects, tin boxes with perforated covers are much better for the larger insects. But do not place all sorts of creatures together in a box or bottle, for if you do you will find when you reach home that some have dined on the others and some of your most interesting captives will be beyond all reach or study. If you plan to collect butterflies, moths, dragon flies, bees, wasps or other winged insects you will need a butterfly net. This should be of light muslin (*not* of mosquito netting) attached to a light brass or iron hoop with a light wooden or preferably bamboo, handle. Some collectors prefer one size and shape of net while others prefer a different kind and size. It really doesn't make any great difference as long as the net is not too large to be used easily or too small to be efficient, provided the bag is at least twice as deep as its diameter. Personally I prefer a conical net about ten inches in diameter and twenty-four inches deep.

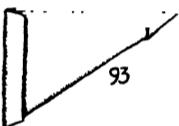
It is a difficult matter to keep winged insects in captivity for more than a few hours, and it scarcely pays to bother

catching dragon flies, butterflies, moths and members of the hornet, fly and bee families unless you wish to preserve them for a collection. In that case they should be killed as soon as captured. Beetles, wasps, hornets and similar insects may be dropped into a cyanide bottle, while the butterflies, moths and dragon flies should be killed by a few drops of benzine or pure gasolene on the thorax.

Many collectors use wide mouthed cyanide jars for these insects, also, but a very large jar is needed to accommodate a big moth or butterfly, and as they do not die



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instantly but usually flutter about for a few moments, they injure their own wings and the wings of other insects in the same jar. Moreover, cyanide is a most deadly poison and even its fumes will kill a human being. Hence it is not safe for general use, and young and amateur collectors will be wiser to use bottles partly filled with liquid formaldehyde, about five percent solution is strong enough, for all insects other than the moths, butterflies and dragon flies. In order to carry these without injury to their delicate wings they should be placed in papers made from the corners of old envelopes. These are made by cutting off the corners diagonally, or they may be made of squares of paper cut and folded as shown in Fig. 92. If envelope corners are used the butterfly or other insect is placed within the paper and the edge folded over as shown

in Fig. 93, whereas if squares are used the insect is placed upon a square as shown in Fig. 94, and the paper folded over it as in the illustration.

The papers containing the specimens should then be packed snugly and smoothly in a box filled with cotton batting to prevent them from shifting and jolting about, and as fast as more are added, bits of the cotton may be removed to accommodate them.

One excellent method of securing moths, as well as night flying beetles, is known as sugaring, and while most effective at night, the same means may be used for securing certain butterflies and other insects during the daytime. In order to "sugar" you must prepare a thick syrup-like mixture of sugar, molasses, vinegar, beer and water. This is smeared or painted on tree trunks, fences, or rocks in the woods or near them. The mess will attract hosts of insects, and by making the rounds with a flash light and insect net you can obtain many rare and fine specimens. Very often you will find the insects so busily eating the sweet mixture or so tipsy from it, that the net will not be needed and you can pick them up with your fingers or a pair of forceps. A thinner mixture of the same ingredients may be placed in jars or pails suspended from trees or bushes, and after being left for a day or two, you will find them filled with beetles, bugs and other insects which have been so greedy that they have been drowned in the liquid. All of the hard-shelled victims, as well as wasps and hornets, may be washed off with water, but moths or butterflies caught in this way are usually ruined. Another excellent way of catching night-flying insects is to place a lantern in the woods or in a meadow and wait quietly with ready net within reach of the light; and if a white

cloth is suspended back of the lantern it will be even more effective as a lure.

If you are interested in the insect boatmen and fishermen and similar strange denizens of ponds and streams, you will require a very different equipment for collecting them. The most useful of all devices for this purpose is an old saucepan, with numerous holes punched in the bottom, attached to a strong handle. With this you can grub up the mud sand and muck from the bottom and by placing this in a bucket of water you will find it alive with all sorts of strange insects and their larvae, together with pond snails, tadpoles, newts and other creatures. But you will seldom capture one of the lively water boatmen or the whirligig beetles in this way. For these chaps you should use a small dip net made of strong mosquito netting. This should be about eight inches in diameter and ten to twelve inches deep with a light handle. Water insects are easily kept in captivity and may be transported safely and readily in jars filled with water with a few water plants and with perforated covers.

Very often, when collecting water-dwelling insects, you will find a number of dead beetles, moths and other land insects along the shores of the pond, lake or stream. If you are making a general collection it will pay you to visit such spots, as well as the seashore if within easy reach, for countless thousands of insects fall into the water and are drowned every day and every night, and while a large part of these are devoured by fishes and frogs, thousands are washed ashore by wind and waves, and quite frequently species never seen alive may be found in this way.

On the other hand, if you specialize in butterflies and moths, the best way to obtain perfect specimens is to raise

them from their caterpillars, and even if you are not making a collection of prepared dead insects, but merely desire to study their habits, you will find that rearing caterpillars is a fascinating pastime. It is very easy also, for all that is necessary is to provide light, air and food plants. Wide-mouthed glass jars covered with mosquito netting do very well for caterpillar cages; lantern or lamp chimneys with netting tied over the top, placed on saucers or plates or on a flower pot filled with earth, are excellent, (Fig. 95), or you may use breeding cages made from old



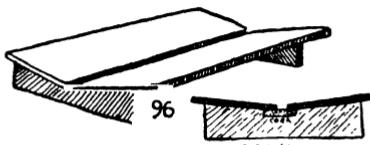
wooden or pasteboard boxes with netting tops. But if you expect to rear the larvae to the chrysalis stage and watch the adult winged insects emerge from these, you must provide your caterpillar captives with the proper environment for pupating. Most butterfly caterpillars suspend themselves by silken bands and transform to naked pupa, and these need no special provision, for the stems or leaves of the plants on which they have fed serve their purpose. Many of the moths, such as the sphinx moths, burrow into the earth to pupate, and these should be provided with ample soil.

It is usually easy to determine when caterpillars are ready to dig into the earth, for at this time they appear to

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shrink in size, they become darker in color, and they act sluggish as if sick or about to die. When these symptoms appear they should be placed in a box or jar partly filled with rather dry loose soil. But if your insect pets pupate late in the summer or in the autumn don't expect to see the fully grown insect emerge until the following spring, for these late broods usually remain in the chrysalis state throughout the winter.

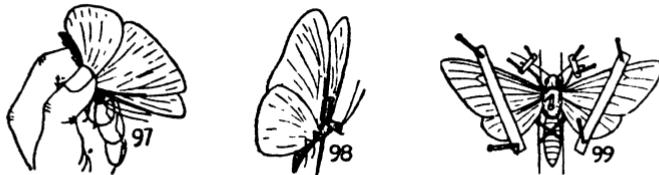
As few persons who become interested in insects can resist the temptation to preserve specimens, and as in-



sect collections are most interesting and educational, as well as attractive, it may be well to give a few simple directions for properly preparing and preserving specimens. No expensive or special equipment is necessary, aside from insect-pins, mounting boards and cases, and as insect pins cost only a few cents a thousand, and as the mounting boards as well as the cases may be made at home in a few minutes, collections of mounted insects are about the cheapest of all specimens for the collector. The mounting or spreading boards are the most important items, for without these you cannot mount an insect properly. They consist of two pieces of soft board (or even strips from an ordinary pasteboard carton), nailed to supports as shown in Fig. 96, leaving a narrow space between them. On the under side of this open space a strip of cork or soft cellular carton should be fastened as shown in the cut.

As insects vary greatly in size, several boards of various widths and varying spaces between them should be made. In addition to these, and the assorted insect pins, you should have numerous strips of heavy paper or light cardboard, such as old visiting cards or Bristol board, of various widths and lengths, some common needles and a pair of small forceps.

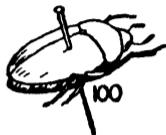
To mount a moth or butterfly, hold the specimen firmly by the thorax, grasping it by finger and thumb, with the wings folded over the back as shown in (Fig. 97), and



press an insect pin downward through the thorax from the back until a little more than half the pin's length projects below the insect's body, (Fig. 98). Next, pin the insect in the groove of a mounting board, selecting one with a groove just wide enough to admit the body, so that the back is level with the inner edges of the two side boards. Then with the point of a needle, press the wings down upon the board, being careful not to tear them, spread them in turn in a natural position, and pin them temporarily in place with very fine pins inserted through the heavy veins at the edges of the wings. When the wings on both sides have been thus arranged with their upper edges in line across the boards, places strips of cardboard over the wings with the ends of the strips projecting beyond the wings, and pin these firmly to the boards with common

pins placed *outside* the wings' edges, as shown in the cut. The temporary pins may then be carefully withdrawn from the wings. Finally, lift up and arrange the legs and antennae and secure them in place by means of tiny strips of paper, or by pins placed on either side as shown in the drawing, (Fig. 99). The boards with the mounted insects should be placed in a cool dry spot free from dust and safe from moths, roaches or mice, where they should remain until the insects are thoroughly dried.

And be careful *not* to place the insects in bright sunlight



as they will be sure to fade if you do. Wasps, flies, hornets and all other soft-bodied insects are mounted in the same way as butterflies and moths, but beetles should be pinned through one of the wing covers instead of the thorax, (Fig. 100), while very small insects may be mounted by gluing them to a bit of cardboard and pinning through this as shown in the illustration. After the mounted insects are thoroughly dry the strips of cardboard over their wings and the pins securing the legs and antennae should be removed and the insects placed in moth-proof cases. These may be of wood with glass covers and with cork on the bottom, to which the insects are pinned, but it is not easy to make cases moth-tight and when many insects are thus mounted side by side they are quite liable to become loose or to move about and injure one another. By far the best method is to keep them singly, or a few to-

gether, in small pasteboard boxes filled with cotton and with glass covers. These may be purchased ready made from dealers in Natural History supplies and are not expensive; but equally good ones may be made from ordinary pasteboard boxes. The box should be filled with even smooth layers of cotton and the insect placed upon this (after the ends of the pin have been cut off with cutting pliers) so that the top of the thorax is a fraction of an inch above the level of the edges of the box when you sight across them. Then lay the glass, which should be cut to exactly the size of the outer surfaces of the box, across it and secure it in place by strips of gummed paper pasted around the edges of the box and the glass. This makes a moth-proof seal, but it is wise to place a few flakes of napthaline under the cotton before placing the insect within the box. These individual mounts are much easier to handle than large cases or trays, they can be stowed away in a smaller space, and the insects will remain "put" no matter how much they are shaken about. Moreover, if one wishes to do so, the insects may be arranged with pressed flowers and leaves making very attractive and natural-appearing groups beneath the glass.

Many persons seem to think that in order to study or collect insects it is necessary to learn their Latin or scientific names, the various orders, families, genera and species of insects, and to acquire a lot of dry and uninteresting scientific knowledge regarding them. But this is not at all necessary, and unless you intend to study insects seriously and to become an amateur entomologist it doesn't matter in the least whether or not you have a scientific knowledge of insects or know their Latin names.

Of course it is an advantage to be able to distinguish a

moth from a butterfly, a fly from a bee, a bug from a beetle, and a caterpillar from a grub, although you will find them all just as interesting, and many of their habits as strange and remarkable, even if you cannot tell one from the other.

And once you become interested in insects you will be anxious to learn more about them and will soon find yourself delving in books which deal with the classification of insects rather than the stories of their strange ways.

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